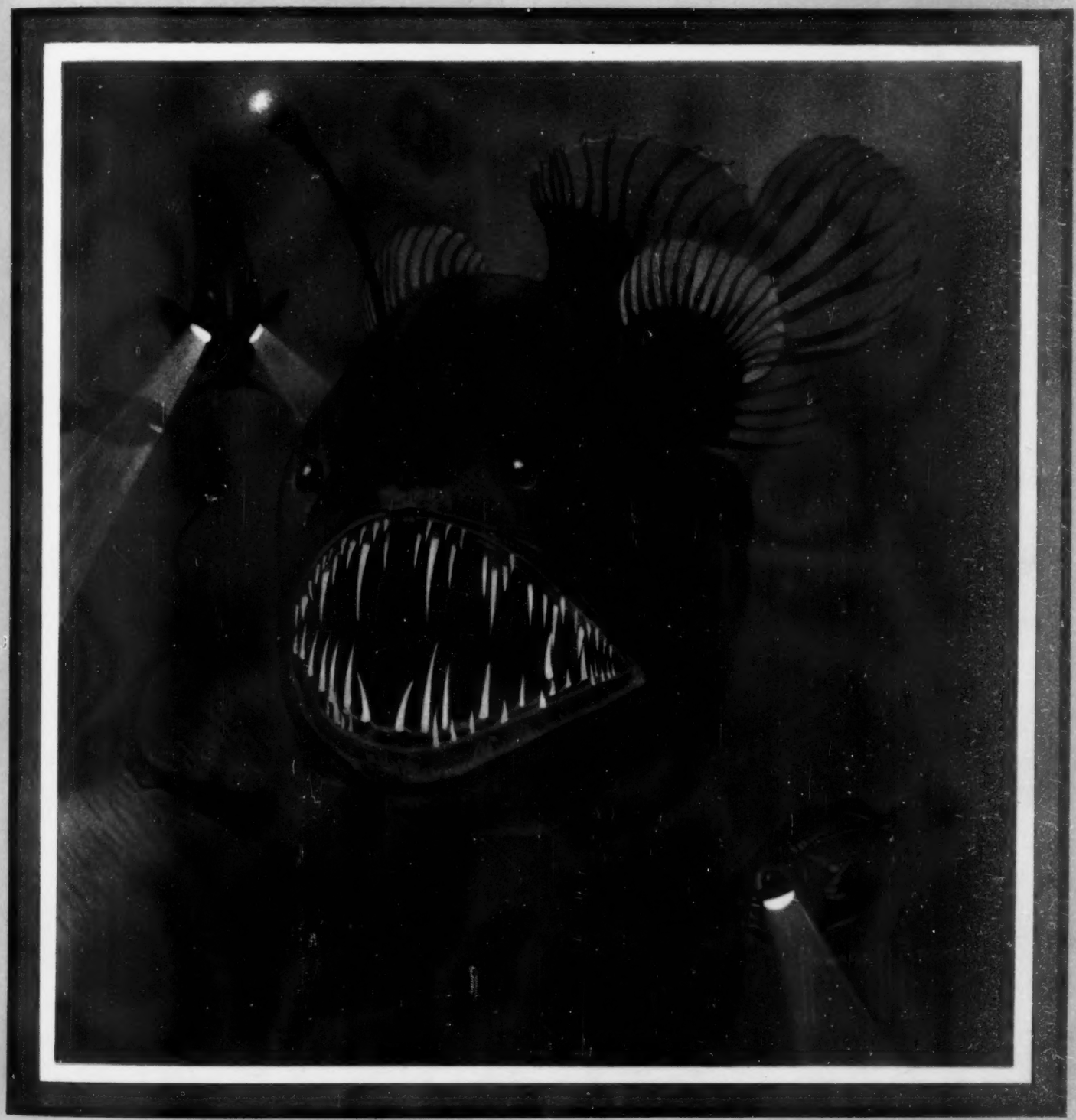
SCIENTIFIC AMERICAN

COLD LIGHTS OF THE SEA
By Dr. David Starr Jordan

MARCONI WAS RIGHT
HAY FEVER—ITS CURE



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OCTOBER 1926

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In traveling from the Mediterranean to Persia the thirty Internationals covered a distance as great as from Canada to Mexico.

MUD—"*The desert was just a bog, as it was winter time and nowhere what might be called a road,*" *writes one of the members of the expedition.*

WATER—*Torrential rains flooded the valleys and rendered even more difficult the early stretches of the journey, through Syria and Mesopotamia.*

SNOW *in the mountains near Teheran. "All the Internationals came through without the slightest mishap. The drivers, all new to the trucks, handled them easily and were most enthusiastic."*

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ANOTHER "Message to Garcia"—the log of the International fleet that trekked across the Mesopotamian wastes at the call of the Persian government!

When famine threatened Teheran, the capital, last winter, the Persian administration ordered its first ten heavy-duty trucks from the International Harvester organization. Harvester world service placed the fleet at the nearest port on the Mediterranean Sea, Beirut, in Syria, ahead of other trucks ordered from Europe.

Then began the test of truck quality, a trip of 1350 miles across trackless desert and over snow-bound mountains. On February 2 the cavalcade set out. The trucks, chauffeured by English, French, Italian, Syrian, Arabian and Druse, were laden with food and fuel and with tons of cement for the British at Bagdad, and they were accompanied by an escort of armored cars of the British Air Forces.

Twenty-six days were consumed between Beirut and Bagdad, every truck axle-deep in mud and sand practically every mile of the way. Bagdad, ancient city of romance, gave the travelers a dinner in their honor and a night of rest, and transferred them from desert to mountain going. Motor fuel for the Persian government, and wheat, took the place of cement for cargo. The cavalcade forged on both night and day, and entered Teheran the seventh day after Bagdad.

The entire fleet was in the pink of condition and every truck of the ten, on the morning of arrival, went out to Kasvin, a hundred miles away and began bringing back great loads of the precious wheat.

The Persian government, impressed by the stamina of International Trucks, immediately ordered twenty more of them, and these have since duplicated the travel history of the first fleet.

The International line includes the Special Delivery, Speed Trucks of 1-ton and 1½-ton sizes, Heavy-Duty Trucks ranging from 1½-ton to 5-ton sizes, Motor Coaches for all requirements, and the McCormick-Deering Industrial Tractor. Served by the world's largest Company-owned truck service organization—120 branches in the United States and 17 in Canada. Write for complete descriptive literature.

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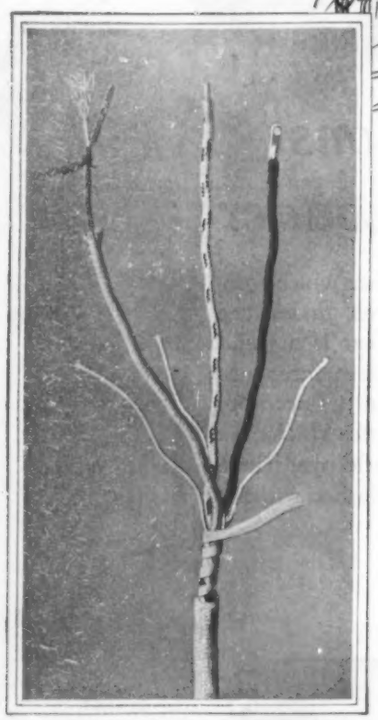

A telephone cord—cut away to illustrate its complex make-up. Silks—strong fibred cotton—waterproofing compounds—cover the vital inner parts, tiny tinsel threads fine as human hairs.

Like Tony Weller's Coats

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LOOK at the cord which leads from your telephone. You'd never suspect that it has seven separate protective coverings.

For all the world like Dickens' famous coachman who, we are told, "wore as many clothes as possible"—protection against rough weather.

So this telephone cord is moisture-proof and hard-knock-proof. That fact isn't so important as is the fact that just such care as this is applied in making every Western Electric product—whether it be a small telephone cord or a year's output of 35 billion feet of insulated wires in cable.

Western Electric

SINCE 1882 MANUFACTURERS FOR THE BELL SYSTEM

SCIENTIFIC AMERICAN

THE MAGAZINE OF TODAY AND TOMORROW

NEW YORK, OCTOBER, 1926 — *Edited by* ORSON D. MUNN — EIGHTY-SECOND YEAR

DEVOTION

IN this month's issue Professor Cockerell emphasizes the fact that everyone everywhere is eager to do a good turn for science. Often we have had occasion to note the same sort of enthusiasm. More than a year ago, in our issue of April, 1925, we broadcast an appeal for help in finding the lost fossil jawbone of a prehistoric man. This had already been found seventy years ago, and lost again, possibly in some obscure corner of America. A reply came from one of our readers, Mr. W. F. Ollis of Mobile, Alabama, stating that the former owner of the fossil, a physician who died some years ago in New Orleans, was his uncle.

At our request Mr. Ollis journeyed to New Orleans, searched diligently for the scattered effects of his deceased uncle, visited places he had lived, the hospital where he died and the Tulane University Museum to which it was thought the doctor's scientific effects might have been sent. Through his instrumentality the city of New Orleans was ransacked.

The invaluable fossil was not found. It may be elsewhere.

But Mr. Ollis did his best, tramping over a great city in a torrid month. He journeyed in the name of science.

EFFICIENCY

"THE fact has been determined by the Secretary of Agriculture that the contagious, communicable disease known as foot-and-mouth disease has been eradicated from and does not now exist in the United States."

Such is the opening paragraph of Secretary Jardine's order revoking a quarantine affecting certain areas in the State of California since February 23, 1924.

It is a good, clean-cut job of applied science; the Scientific American congratulates the men in the department for their efficiency.

PROGRESS

THE *Antinoe* did not go down in vain.

Foundering at sea, the steamship *Antinoe* sent out an SOS call. The radio on the *Roosevelt* picked up the message and started for the stricken vessel. The latitude and longitude given in the call for help were wrong and the *Roosevelt* found itself a hundred miles out of the way. There was a radio compass aboard, however, and with its aid the storm-stricken vessel was found and the rescue completed.

Now the Bureau of Navigation reports that the radio compass, or direction finder for ships, has been installed on twenty-three vessels.

In This Issue

Fish That Carry Flashlights
Down in the cool depths of the sea there is no light—only inky, perpetual night. Yet fishes manage to live there and capture their prey. How? They carry headlights. Science has learned some interesting things about these headlights. Commencing on page 247 some of them are told.

***How Did They Raise the* S-51?**
What were the facts? Couched in accurate engineering language by a naval engineer, this romantic struggle with the elements is narrated on page 257 by Lieutenant-Commander Edward Ellsberg. How he comes to *know* the facts is simple—he was in command of the job!

Are We Still in the Glacial Period?
Nobody knows. "Come back in 100,000 years and find out"—this is the best answer science can offer. The ice cap that covered continents long ago may return. This is one of the legitimate sensations of science. Few that have not read the article on page 272 are likely to realize how many glacial periods this ancient earth of ours has already experienced.

Man and the Insects at War
An all-devouring beetle threatens to spread across America. Pending the discovery of a way to cope with it, government experts are penning it within the area of a few states. How long can they keep it there? Will any of the eleven bugs that have been imported to prey on it be able to exterminate it? On page 276 the remarkable account of this new insect war is presented.

MORE THAN 200 PICTURES

Complete table of contents will be found on page 319.

For Next Month

How Long Has Man Been in America?—A Controversy
In the issue of July a noted scientist, Dr. Ales Hrdlicka, denied that the Indian had been in America long. But other scientists say otherwise—man was here when the glaciers were here, and perhaps before that. Next month we shall publish a rejoinder to the article which appeared in the July issue.

"Tin-clad Suicide Ships"
Thus does a noted naval critic charactertize the new Washington Treaty cruisers that every nation is now building. Costing $10,000,000 apiece, he says they are simply speed machines, vulnerable to a degree unprecedented. What shall we do about it? The next issue offers a solution.

Radio 1926-27 Fashions
New radio styles which will be in vogue this winter will be described and illustrated in the November issue. The article will include helpful information for broadcast listeners regarding battery eliminators and the possibilities of future development of current supply devices which dispense with batteries.

Other articles on Navy Signaling; The Movement of Your Eyes When Reading; A Monster Storm Sewer; The Most Powerful Machine on Earth; Insect Classifications; Mortalities; Conservation; Radio; Astronomy.

MORE THAN 200 PICTURES

BLUFF

THERE is no man living today who knows all, or even an appreciable part, of science. One man can learn one branch of science fairly well, some sub-phase of that branch very well or nearly the whole field of science in a superficial manner.

Today, frank admission of ignorance concerning a given matter in science is no disgrace. The great Loeb, biologist of world fame, while teaching a class in embryology early in his career, was asked a question. His reply was, "My dear young lady, I cannot answer your question, because I have not yet read that chapter of the textbook myself, but if you will come to me tomorrow, I shall then have read it, and I may be able to answer you."

Yet Loeb was one of the world's greatest scientists. He wasn't afraid to say, "I don't know."

FAKERS

HAVE you had your radium today? This seems to be the thought that many drug and "health water" manufacturers are trying to put over. The amount of radium contained in the various substances that are being vended as having curative properties due to their radium content has been investigated by the Bureau of Chemistry of the United States Department of Agriculture. The findings have been that only 5 percent of the products analyzed contain radium.

Even though many of the medical products that are advertised to contain radium do not have such material in their make-up, a warning should be sounded against the use, by the inexperienced person, of any curative medium that *does* contain radium.

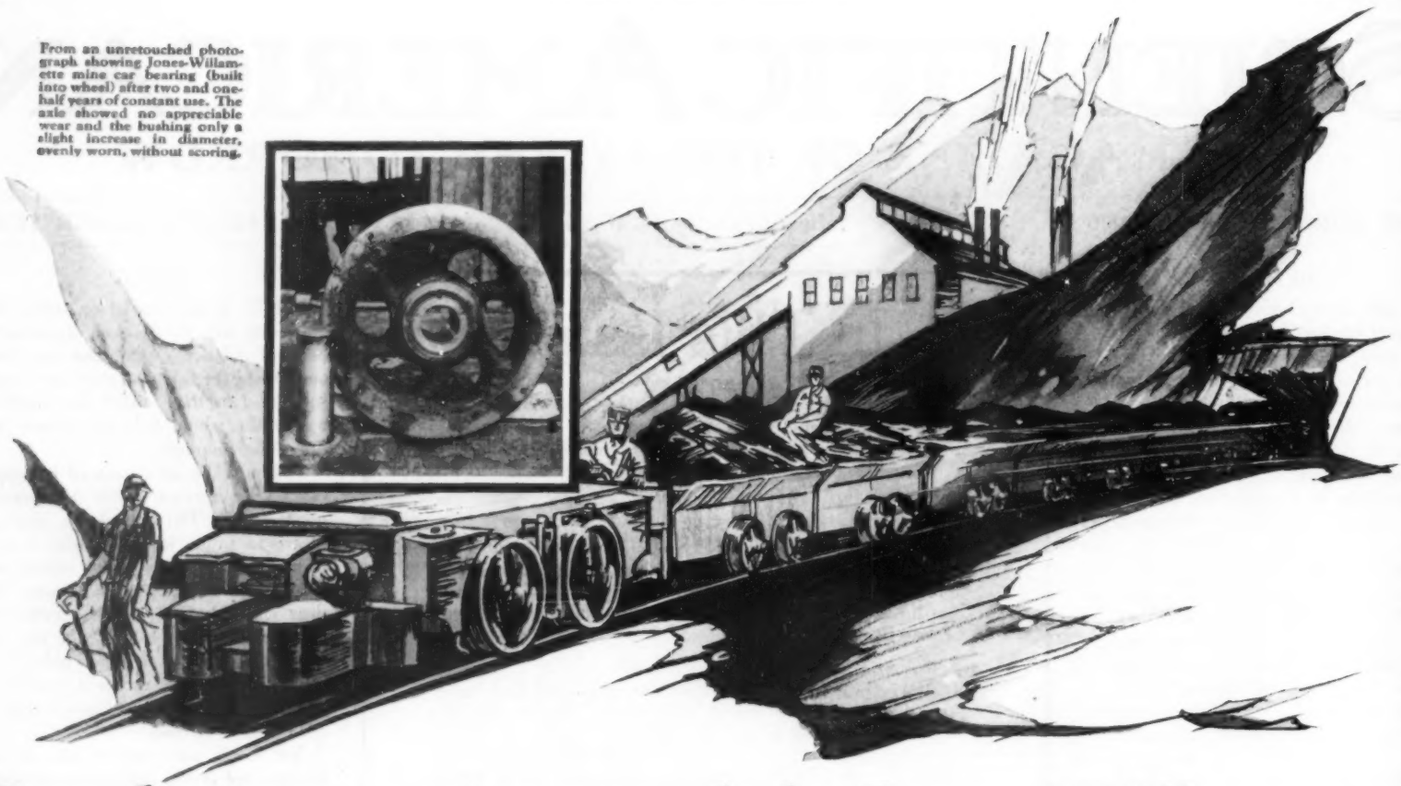
"Radium in active dosage," says the Department of Agriculture, "is potent for harm as well as for good and should be administered with caution."

BIRDS

WHERE do the chimney swifts go in the winter? Nobody knows—yet.

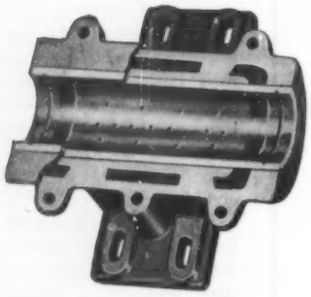
Until comparatively recently it was thought that these strong flying birds buried themselves in the mud on the Gulf of Mexico. Now the theory is that they migrate across the Gulf of Mexico and winter in the rain forests of Brazil.

Back in the days when investigation and heresy were synonymous, the wise men would have reasoned it out and arrived at a wholly logical, but incorrect, answer. Today we do things differently. The Bureau of Biological Survey is trapping more than 25,000 of the birds, putting identification tags on them and letting them go again in an effort to trace their movements.



From an unretouched photograph showing Jones-Willamette mine car bearing (built into wheel) after two and one-half years of constant use. The axle showed no appreciable wear and the bushing only a slight increase in diameter, evenly worn, without scoring.

Five *distinct savings* made by Jones-Willamette mine car wheel bearings



OIL TIGHT
LESS FRICTION
LASTS LONGER

Action of shaft automatically filters and circulates oil to points of greatest load and friction. Complete lubrication means long life. Bearing completely oil sealed—oil cannot escape nor water enter.

Jones-Willamette mine car bearings have been tested for more than two years in the hardest kind of actual use. During this time the following economies have been fully demonstrated:

OIL ECONOMY—The Jones-Willamette bearing uses approximately one-tenth the oil consumed by other types of bearings, simply by *keeping the oil in after it is put in.*

REDUCED WEAR—Continuous use for two and a half years showed no appreciable wear on axle and very slight wear on bushing. Perfect wheel alignment is the result—no sharp flanges and no cutting of tracks.

POWER SAVING—Tests on mine cars show that substantially less tractive force is required. This is an important power saving, both in operating mine trains and in shifting mine cars by hand.

LABOR SAVING—Instead of constant wasteful oiling at the mine mouth, cars equipped with Jones-Willamette bearings require oiling only once every six or eight weeks. The expense of sanding and of cleaning oil from tracks and mine structures is eliminated.

REDUCED DEPRECIATION — Jones-Willamette equipped mine cars can be run over water and muck covered tracks without sand, grit and water getting into the bearings.

These bearings *keep the oil in and keep everything else out.*

Wheels and bearings are also manufactured for all types of industrial cars and trucks. They give these same economies. Write for information regarding Jones-Willamette bearings, now available in both standard and special types for every industrial use.

Willamette Iron & Steel Works, Portland, Oregon

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Distributors: A few good territories are still available. Write or wire.

[Jones] Willamette
VACUUM CIRCULATION
Bearings

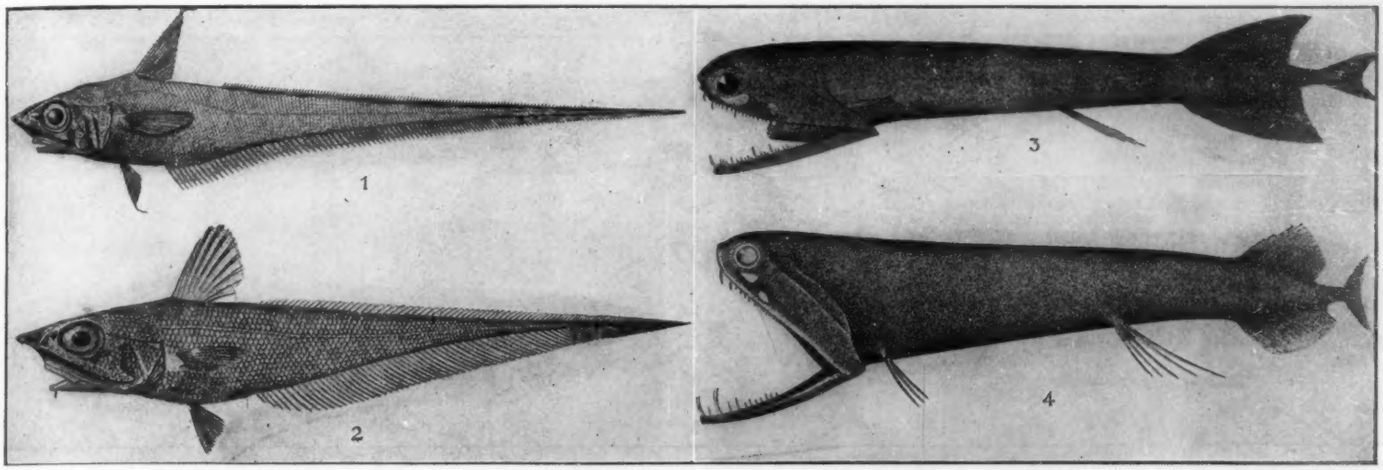
Senatore Guglielmo Marconi, the Prophet of Short-Wave Radio Transmission

To this well-known scientist must go the lion's share of the credit for the commercial development of communication by radio. Born in 1874, he was only 27 years of age when he devised the radio apparatus that successfully transmitted the first signal across the Atlantic, without wires. Before that, in 1899, Marconi succeeded in spanning the English Channel by radio, or wireless, as it was then popularly termed. From that time on, progress was spectacular. Shipping interests speedily adopted the new form of rapid communication and the science grew apace. In 1922, Marconi predicted that, in the near future, the short wavelengths below 100 meters would be found of great value. After only four years, the prophecy has already been realized, as is evidenced by the fact that amateur and commercial radio stations are transmitting to the antipodes and beyond, with a very small amount of power. The next development that Marconi will announce is conjectural and it will undoubtedly be seized upon with alacrity and subjected to tests by all interested parties.

Photograph from Wide World, by Harry Burton, Metropolitan Museum of Art, New York City

The Head of Tut-Ankh-Amen, with Its Final Wrappings Removed

The actual mummified body of Tut-ankh-amen has at last been revealed. Difficulty was experienced in dealing with the mummy for it was in a very poor state of preservation. The ancient embalmers did their best, but the Egyptian burial custom more or less defeated them. Unguents used in the final consecration of the body destroyed the fabric with which the body was wrapped and also caused the mummy to adhere to the coffin. Being of a fatty matter—resin and perhaps wood pitch—the unguents decomposed in the course of centuries, and therefore the scientific unwrapping which had been hoped for could not be carried out. Tut-ankh-amen's resemblance to Akh-en-aten, his father-in-law, is particularly striking and the *Illustrated London News* suggests that he may have been a son of Akh-en-aten by a wife of one of the less official weddings of that ruler.



FISHES THAT CARRY THEIR OWN SOURCES OF LIGHT WITH THEM

1: Macrourus bairdi *G. and B., from Massachusetts Bay. 2:* Coelorhyncus carminatus *G. and B., near Martha's Vinyard. 3:* Malacosteus niger *Ayres, a small lantern-fish from George's Bank, Newfoundland. 4:* Malacosteus choristodactylus *Vaillant, a split-fingered lantern-fish from the eastern Atlantic, with very minute luminous spots*

Cold Lights of the Sea

Fishes Which Inhabit Great Depths Carry Their Own Lanterns

By David Starr Jordan

Chancellor Emeritus, Leland Stanford Jr. University

IT has long been inferred, and for many years positively known, that the depths of the sea are cold and dark. We were not sure whether or not they were inhabited by any form of life. Poets have assured us that in these regions "sweet flowers are springing, no mortal can see" but botanists have never favored this view, and for generations naturalists believed that we should never find out the truth. But in the last century the explorations of the great dredging steamers the *Challenger*, the *Albatross*, the *Travailleur* and the *Talisman* with the fleet of Prince Albert of Monaco, gave us complete and accurate knowledge of the life in the "somber retreats of the ocean."

These explorations have brought to light the fact that fishes occur at all depths, even down to four or five miles below the level of the ocean. The fishes of the surface, in the open sea, are all metallic blue above, colored like the sea itself, as a defense against predatory birds who attack from above. At the same time they are silvery white beneath, invisible to enemies below, to whom they appear to be colored like the sky.

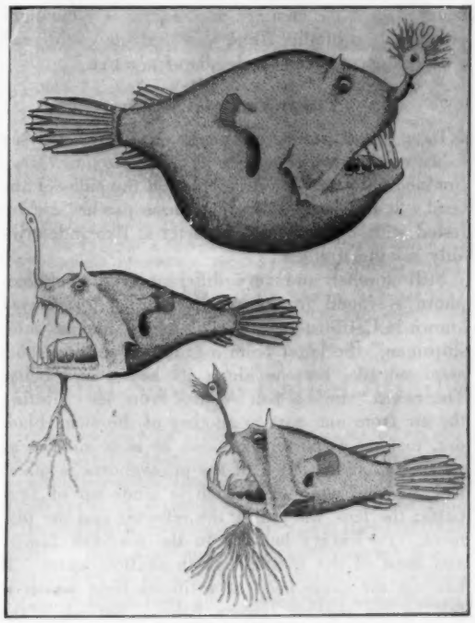
Their Light Has No Heat

The great majority of fishes live in shallow waters, near shore, around rocks or along sandy beaches where they swim in the shallow surf, seldom wandering far from home. Shore fishes are variously colored; some silvery, and some with protective markings of one kind or another which are very effective in hiding the fish that bear them. Besides these, multitudes of little fishes with colors so bright as fairly to be termed defiant swarm around coral reefs in the tropics. These gaudy creatures are swift as chain lightning, and seem to need no protection as they find their way instinctively into all the crevices in the reef.

Further down in the open sea at about the depth of the red sea-weed, we find fishes largely plain red, which color usually replaces the yellows, greens, and blues of the rock fishes of the reefs. Beyond the depth of a few hundred feet, the reds give way to dark purplish and then to inky black. We now know that black is the invariable color of all fishes from about a thousand feet down to five miles, the greatest depth reached by the beam trawl, the present method of deep-sea angling.

The first fish from the black depths was taken in 1810, off Messina, by Constantine Rafinesque. It was a little black creature with big eyes. Its body was marked with many round white spots, which were luminous in life, although its discoverer did not know it. He gave it the name of *Myctophum*, supposed to mean night-light (hence by some changed into *Nyctophos;* a good name but not the one intended, for it was not suspected of any relation to light, save in its black color).

Later collectors have dredged more than a hundred different species of the type of *Myctophum*. We have found that they swarm in almost all seas and at great depths, but unlike most of their kind they are sometimes caught by storms and thus raised to the surface. They are called "lantern fishes," because as we now know, all these round white spots shine in the dark. The light they give out has no heat and so I have called them "the cold lights of the sea." All of them have very large eyes and they find their way in the dark by the aid of the lanterns they carry. In all cases these lanterns are many, and are variously placed in the different species. They are usually ranged in broken rows along the sides of the head and body. In two species those in front are enlarged to cover the whole front, like the head lights of an engine.



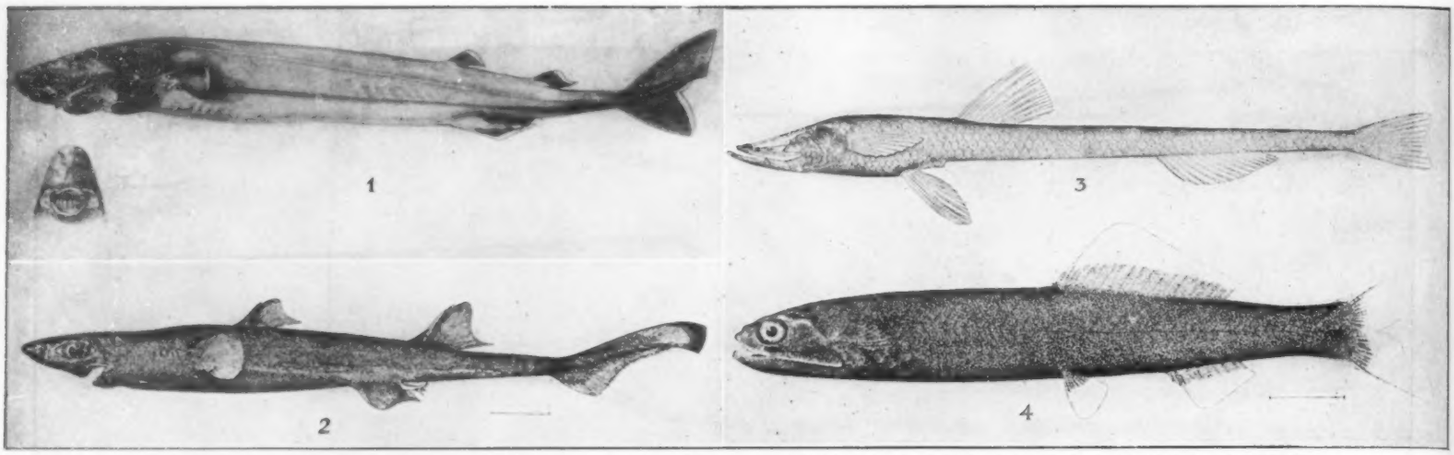
FISHES THAT FISH

These fishes carry luminous glands above them. When smaller fish nibble the bait they are engulfed. 1: Borophryne apogon *Regan. 2:* Linophryne macrodon *Regan. 3:* Linophryne polypogan *Regan*

The luminous spots are known technically as photophores (light bearers). In most cases among the lantern bearers they are small and round, about the size of pin-heads, either raised above the skin or sunk into it. They are sometimes simple, plain shining spots ringed with black pigment. More often each contains a bright reflector, in which case, when they are brought up in a dredge, they "shine like little stars of the sea." Sometimes each spot is divided by a little cross-partition, their form then being comparable to the Greek letter Theta (θ). Most of the substance of the luminous organ is granular, excreting slime, which too may be more or less luminous. While this light is produced by oxidation there is no evidence that any heat whatever is developed in connection with it.

Light Not Due to Bacteria

Many of the phenomena known as phosphorescence, as that of decaying wood, (known in the eastern states as "fox-fire") and that of decaying fish ("a mackerel in the sun") are said to be due to the presence of luminous bacteria. But with the photophores of fishes this is not the case. The more life in the fish, the more light is given out. Recent students say that all animal light is due to two substances, Luciferin and Luciferase. The first is a fuel, the second a sort of ferment necessary in the oxidizing or burning of the fuel. But such combustion produces cold light, with little or none of its energy side-tracked as heat waves. It is hoped that through the study of Luciferase, some way may



FISHES THAT SWIM IN THE DEPTHS OF THE SEA, FAR BELOW THE THOUSAND-FOOT LEVEL TO WHICH DAYLIGHT PENETRATES

1: Isistius brasiliensis *Quay and Gaimard, the green-light sharklet, a very rare species found in the open sea. The whole belly shines with green light. (Drawing by Stanley C. Ball). 2:* Etmopterus lucifer *Jordan and Snyder, the shining or lucifer sharklet, from Sagami Bay, Misaki, Japan, taken in 1,500 fathoms, on a hook and a half-mile line. The sides of the belly are luminous. 3:* Ipnops murrayi *Günther, from the West Indies. The eyes and forehead are united in one luminous plate. 4:* Bathylaco nigricans *G. and B. of Santa Cruz Island, West Indies. It is not luminous. All of the illustrations on this and the preceding page are from one-quarter to one-half life size*

be found for producing it artificially, and from it, white cold light.

There seems to be nothing in common between the light organs of fishes and those of fireflies and other insects which possess luminous organs. It is also evident that the five types of phosphorescent structures found among fishes are derived independently, through the agency of a common need, and not from common heredity. They appear in different groups of fishes apparently not related to one another, and each group develops its own particular structure.

Another type of lantern, quite different in structure as well as in purpose, is found in the bait offered by a few kinds of deep-sea anglers, known as sea-devils and fishing-frogs. In these fishes the first dorsal spine is elongated and turned forward, its tip provided with a fringe of tentacles. In the center of this bait is some sort of a luminous gland. These are turned forward over the big mouth, and the little fishes which nibble at them are suddenly engulfed.

A third type of luminous organs was lately found by Mr. F. M. Hickling, in a species of grenadier (*Malacocephalus lævis*). This deep-sea fish was examined in life in the deep sea off the continental rim, between Ireland and Morocco, "where the submerged edge of the continent begins to plunge rapidly down to the depths of the Atlantic Ocean." The belt is frequented by the beam trawlers, which scrape up from the depths many edible fishes unknown to the public at large. The fish studied by Mr. Hickling belongs to the large group called grenadiers or "rat tails" (*Macrouridæ*). The front of these fishes is impressive, looking like a high-brow cod-fish; the tail is long, slim and rough, like the tail of a rat. It is easy to see the origin of each of the common names.

While many deep sea fishes carry lanterns, none had been reported before among the grenadiers. The one in question has light organs quite different from any found in any other group. The fish is about a foot and a half long, and it lives at an enormous depth. Its lantern is a large gland lying in the skin of the belly. One gland is on each side of a little scaleless patch. From this gland, under pressure of any sort, a slimy luminous secretion is poured out in abundance. Everything becomes smeared with it; the fish itself, the net of the trawl, the surface of the deck and the hands of the fishermen "glow with a blue light. If a live fish is thrown back into the sea, the luminous slime makes a glowing disk of light as large as a soup plate, behind which the creature disappears. By the light of a solution of this slime in water one could read a newspaper or read the hands of a watch."

Piscatorial Songsters

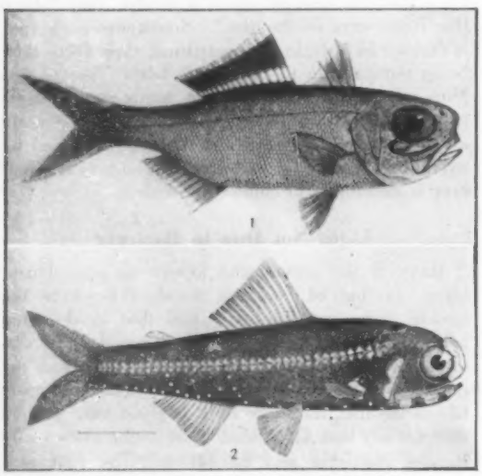
In a fourth group, composed of a few deep sea fishes of the tropics known as *Anomalopidæ*, large luminous blotches are developed on the sides of the head. It has been shown that these patches are infested with light-producing bacteria, like indescribably minute fireflies.

Still another and very different type of photophore is found in the small group *(Porichthys)* known in California as "singing fishes" and as "midshipsman," the latter from a group of shining spots arranged like buttons along its breast and belly. The name "singing fish" comes from its crowding the air from one part to another of the swim bladder, making a quavering noise, as near singing as a fish can come. Each of the photophores is spherical, shining white, and each is made up of four parts; the lens, the gland, the reflector and the pigment. *Porichthys* belongs to the toad-fish family and most of the species live in shallow water. It has not the same need of artificial light which is felt by the regular lantern fishes. But while the California and Texas species live in shallow water and are not black, but brown in color, with flesh and naked skin of firm texture, there is another species of the same group found off the coast of Panama in fairly deep water. This species is darker in color, of softer substance and can perhaps make better use of its privileges than our "singing fish."

Under ordinary conditions the light of *Porichthys* does not appear at all, but it becomes very bright under stimulation of ammonia or by a strong current of electricity, although even this seems only slightly effective in examples drawn from deeper water. In this, as probably in all cases, we have some degree of oxidation, burning as a cold fire in the mucous fluids.

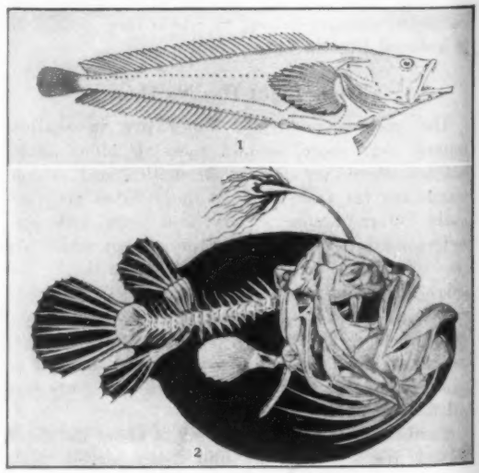
A fifth and very different type of luminosity occurs in several sharklets in the deep seas. In these the whole belly is faintly luminous, shining with a diffuse green light. One of these creatures, about a foot long and jet black, *(Etmopterus lucifer)* was once brought up from a great depth in Sagami Bay, Japan. A drawing of this species was later made at night, by its own light, from a living example, by a Russian naturalist, Peter Schmidt, at Misaki. The same diffusion of green light has been noticed in other small deep-water sharks, especially in the little known genus, *Isistius*. No light producing structures have, however, been discovered.

The whole range of phenomena of cold light under the sea is a very interesting one, and it still offers room for much further investigation as does also the kindred one of "torpedo" fishes, which yield vigorous electrical shocks.



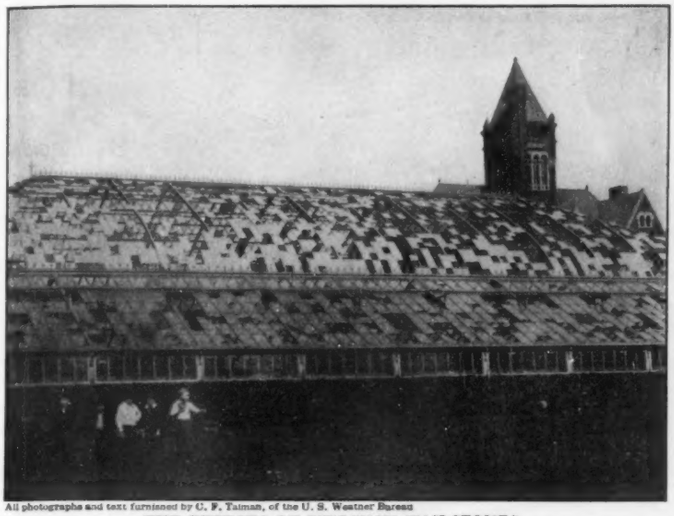
BACTERIA WORK FOR THESE FISHES

Some deep-sea fishes have luminous spots due to light-producing bacteria. 1: Anomalops palpebrata *Kaup, from the tropical Pacific. The tract under the eye is shining white in the live fish. 2:* Aethoprora effulgens *Goode and Bean, from Gulf Stream, Gulf of Mexico. About one-half natural size*



SOME "SING," SOME GO FISHING

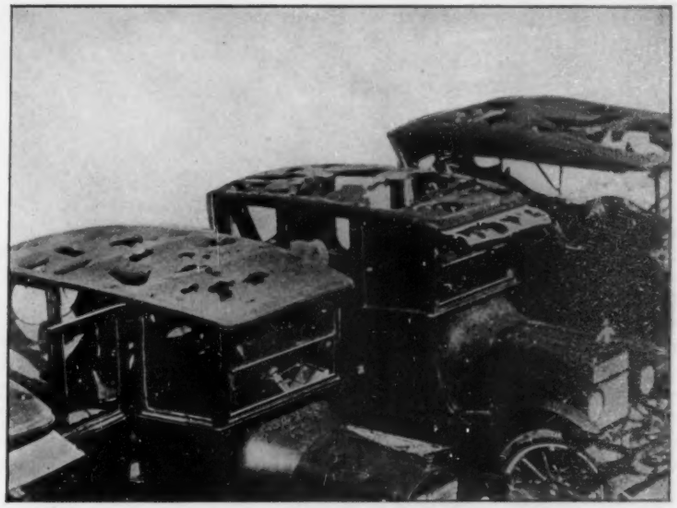
1: Porichthys porosissimus *Cuvier and Valienciennes, the Mexican singing fish from the Gulf of Mexico. It is smaller than the Californian singing fish but has larger teeth. 2:* Himantolophus groenlandicus *Reinhardt, the Greenland sea devil. When turned forward, the luminous tentacles act as bait*



All photographs and text furnished by C. F. Talman, of the U. S. Weather Bureau

THE EFFECTS OF TWO-INCH HAILSTONES

The Public Conservatory at Allegheny, Pennsylvania, after the storm of May 20, 1893, in which many hailstones were from 1½ to 2½ inches in diameter. The hail lasted only five minutes but broke thousands of dollars worth of glass. The ground was pitted with holes for weeks after

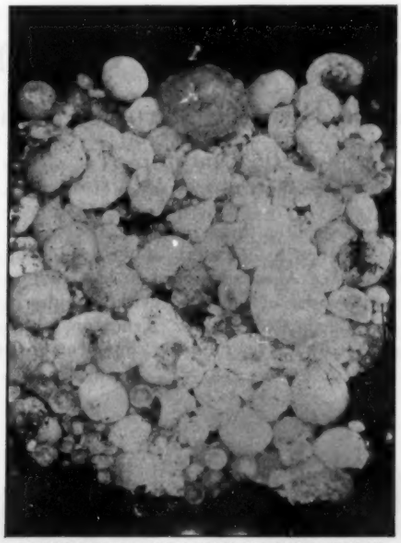


A NEW HAZARD OF THE HAILSTORM

This picture shows how a few thousand automobiles looked after the tremendous hailstorm in Dallas, Texas, on May 10, 1926, which did damage in that city estimated at 2,000,000 dollars. Roofs of street cars were similarly punctured and many tile and shingle roofs of houses were wrecked

A CORN FIELD DEVASTATED BY HAIL

In an average year standing corn in this country is damaged by hail to the extent of nearly 14,000,000 dollars. No wonder hailstorm insurance has become popular in the corn belt!



GARNERED FROM A KANSAS HAILSTORM

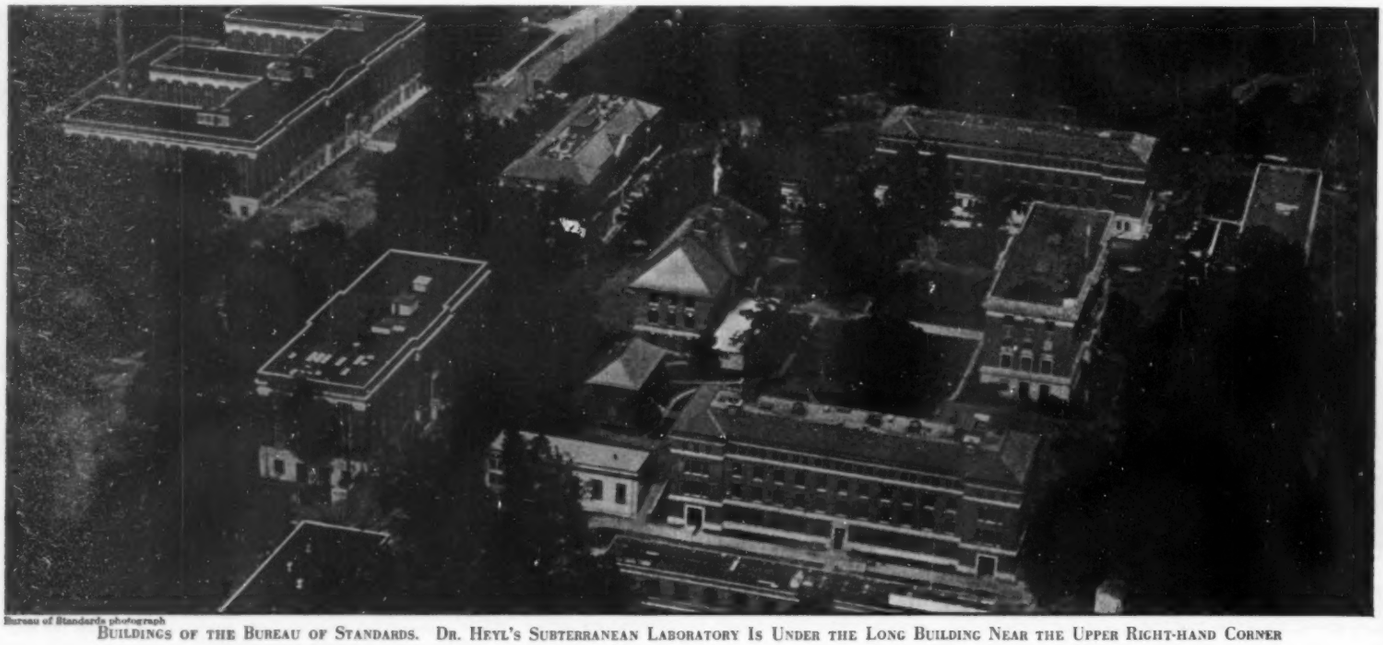
The question asked after a severe hailstorm is, "How big were the hailstones?" The stone marked 1 in the above picture was 13½ inches in circumference; greatest diameter about five inches. Much larger hailstones have been reported, but they probably resulted from the melting together of several stones lying closely packed on the ground. Hail sometimes falls in astonishing quantities. The day after the great Baltimore hailstorm of May 24, 1925, a fleet of 40 trucks and wagons was required to remove the huge drifts from the streets. Hailstones have been known to pierce a pane of glass with a hole like that of a bullet, without cracking the glass, and also to bury themselves a foot and a half deep in the ground

WORSE THAN THE BOLL WEEVIL

Cotton stripped of all its leaves by a hailstorm. The annual hail loss of this crop is more than 7,000,000 dollars. In the northeastern states, tobacco is a special sufferer from hail

The Direful Scourge Called "Hail"

What is hail? The answer to this question is not quite so easy as you might suppose, and differences of opinion on the subject have led to much confusion. Besides snow, three distinct kinds of icy particles fall from the sky. One consists of little lumps of clear ice, which the U. S. Weather Bureau calls "sleet." Another takes the form of miniature snowballs, about the size of coarse shot. This is called "graupel." Both sleet and graupel fall only in cold weather. True hail is a by-product of thunderstorms. It consists of icy lumps ranging from the size of small peas up to and exceeding that of big oranges. The lumps assume a great variety of shapes. A typical hailstone has a snowy center, surrounded by from one to a dozen or more coats of alternately clear and snowy ice, arranged like the skins of an onion. Hail, being an attendant of thunderstorms, is most common in warm weather, but it occurs also with the rare thunderstorms of the cold season and of the polar regions. Hail is one of the most destructive of atmospheric agencies, doing damage estimated to average more than 200,000,000 dollars a year throughout the world. The greatest losses are borne by field crops. In Europe, vineyards suffer heavily, and everywhere the glass roofs of greenhouses are favorite targets of hailstones. For some reason that has never been satisfactorily explained, human beings are seldom killed or badly injured by hailstones. Most of the fatalities thus far recorded occurred in India, and were confined to a few storms of extraordinary severity, such as are seldom experienced elsewhere.



Bureau of Standards photograph

BUILDINGS OF THE BUREAU OF STANDARDS. DR. HEYL'S SUBTERRANEAN LABORATORY IS UNDER THE LONG BUILDING NEAR THE UPPER RIGHT-HAND CORNER

The Wonder of the Commonplace

". . Tongues in Trees, Books in the Running Brooks, Sermons in Stones . . " *As You Like It*

By Dr. Paul R. Heyl

Physicist, United States Bureau of Standards

"I CANNOT tell you how much I have enjoyed this visit," said a lady, one of a party of visitors who had been shown through the laboratories of the Bureau of Standards. "And now to think of going back to the commonplace things of life! You are fortunate people here. And yet," she added, reflectively, "I suppose that you are so accustomed to all these wonderful things that you regard them very much as you would—well, a falling stone."

For the honor of the craft it was my impulse to deny this, but something stopped me; and the train of thought started by her last remark continued long after the visitors had gone. Were we or were we not guilty as charged? And yet is it not true that if we do not regard all these wonderful things in the same light as a mere falling stone, at least we ought to do so? Not that we should allow ourselves to become blasé, irresponsive to the flickering glow of the vacuum tube or cold to the story told by the spectroscope, but rather that we should be equally sensitive to the wonder of the commonplace.

The Poet as a Scientist

There is nothing in all Nature more wonderful than anything else when we stop to think about it. For not even the most trivial happening can we as yet give any ultimate explanation. It is true that there are many things which we have come to regard as commonplace, but they have lost for us their real wonder only by reason of familiarity; for familiarity, like slowly settling dust, gradually masks everything under a uniform, uninteresting gray. The child has the advantage of us, and we may well envy him, for to him everything is wonderful because everything is new. Every one of us in infancy has had the correct point of view, and if with advancing years we have lost it, the fault is not in our stars, but in ourselves that we are underlings.

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There have been those who have not lost it. Newton did not, as the story of the falling apple bears witness. Agassiz retained to his latest years the fresh wonder of the child at the simplest phenomena of animated Nature. Tennyson, although not professedly a scientific man, showed us that the

P. & A. Photos

DR. PAUL R. HEYL

Dr. Heyl is reweighing the earth at the Bureau of Standards

scientist and the poet are blood brothers when he said of the flower in the crannied wall:

". . . If I could understand
What you are, root and all, and all in all,
I should know what God and what man is."

True, we are not all Newtons or Tennysons. Far from it; some of us have even sunk so low as to swear at the telephone, and are beginning to be a bit impatient with the radio. Yet every one of us can do much toward throwing off the benumbing influence of familiarity. We were none of us born without the capacity to wonder, and this great gift cannot yet be wholly dead in anyone who thinks it worth his while to read the pages of the Scientific American. It has been well said that the remedy for the ills of democracy is more democracy; and the most potent antidote for the effects of familiarity is a more intimate acquaintance with the real nature of commonplace things.

Our lady visitor doubtless mentioned the falling stone at random, yet by the most careful thought she could hardly have done better; for, as we shall see, a falling stone is full of interest from every possible aspect. The shape of its path is wonderful; the speed with which it moves in this path is, if possible, still more wonderful; and even deprived of its motion and lying inert upon the ground it is still full of interest to those who can understand the language which it speaks.

And here, I think, lies the great difficulty. As the traveler unacquainted with the speech of a strange country is at the mercy of the unscrupulous, so our inability to understand the tongue of the trees, the language of the brooks and of the stones is perhaps the greatest ally of familiarity in its insidious efforts to close our eyes to the wonders that surround us; but the dust of familiarity disappears under the breath of the interpreter.

The Phenomenon of a Falling Stone

At first glance it may seem the height of absurdity to invite comparison between the most magnificent spectacle in the heavens—the rings of Saturn, and the behavior of a stone thrown from the hand; yet a little consideration will show us that the two are essentially one in nature, equal in wonder and mystery.

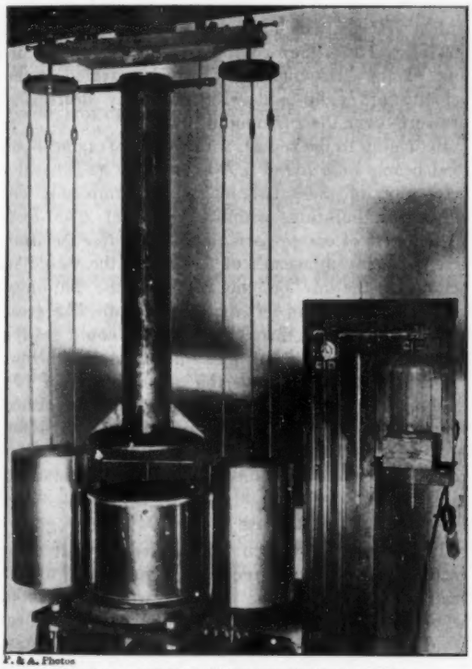
The classic investigations of Keeler at the Allegheny Observatory have shown that the rings of Saturn consist of a collection of myriads of small bodies (we may fairly call them stones), each circling around Saturn in its proper orbit; millions of tiny satellites, each in its path obeying the same law of gravitation that prevails at the earth's surface and

governs the action of a stone after it leaves the hand that throws it.

A stone thrown upward at any angle describes a curved path and returns to the earth. The mere fact of this return is a wonderful thing, although we do not usually make as much of it as we do of the return of a boomerang. As a matter of fact, we know a good deal more about the reason for the return of a boomerang than we do about that for the return of a stone, for the ultimate nature of gravitation no man knows—not even Einstein.

The shape of the curved path of the stone is also full of interest. Making allowance for air friction, it is a portion of a large ellipse about the earth's center.

If we were to fire a bullet horizontally from the peak of a high mountain, it would not go very far before reaching the earth by a curved path which is also a portion of a large ellipse. The greater the initial speed of the bullet the farther it will travel before striking the earth; in other words, the wider (and shorter) the ellipse will be. If it were possible to give the bullet an initial speed of five miles per second and to eliminate air friction, the bullet would clear the earth in its fall, and continue to revolve around it forever, the ellipse having widened and shortened to a circle. The earth would thus have acquired a tiny new satellite. With a plentiful supply of ammunition we might thus create for the earth a ring system remotely resembling that of Saturn.



F. & A. Photos

ABOUT 6,000,000,000,000,000,000,000 TONS!

The Cavendish torsion balance used at the Bureau of Standards for redetermining the mass of the earth

Mysterious and wonderful as the action of gravitation may be in the heavens, it is no whit less wonderful in its action on the pebble which we toss carelessly from our fingers; and the action of gravitation at close quarters should, if anything, be the more interesting because it is here available for study and measurement by the searching processes of the laboratory.

Here again we see the baneful effects of familiarity. The Bureau of Standards possesses a model of the Boys gravitation apparatus, by which the attraction of a five-pound mass upon a smaller mass of about an ounce can be made visible by the motion of a spot of light across a scale. Visitors will climb two flights of stairs to see this model, raising their own weight more or less laboriously against the earth's attraction, and think nothing of it; yet the action of the gravitational model never fails to evoke expressions of wonder.

Not only is the mere shape of the path followed by a falling stone wonderful, but its speed in this path has attracted the attention and serious study of many careful observers. It is a curious fact that (allowing again for air friction) all bodies without exception fall with equal speeds from equal heights.

"Let Down Your Bucket Where You Are"

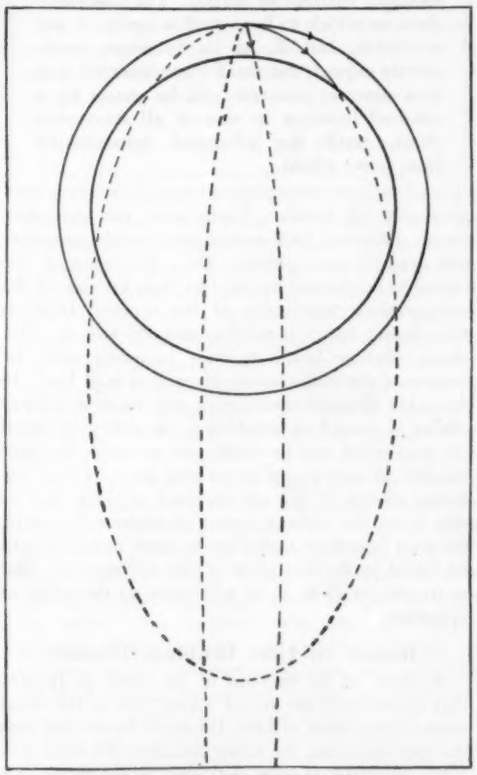
How instinctively do most of us turn, when we seek romance, to places far afield, forgetting that what we seek may lie already beneath our unobserving eyes, clothed in the everyday disguise of the commonplace. We raise an arm—can we explain that? Partly. When we read these words and "think," has anyone ever explained that? Yet are not these simple, commonplace acts performed by each of us a thousand times daily?

To few scientists is it given also to be philosophers. Of these, Dr. Heyl is one.

The Editor.

The great Greek philosopher Aristotle held the contrary view that bodies fell with speeds proportional to their weights, and supported this doctrine, as was the custom of his day and for many centuries after, not by experiment, but by a subtle process of reasoning. It seems curious that such a statement should have gone unchallenged for eighteen centuries when the very simple experiment of dropping a heavy and a light stone together would have disproved it; yet we have no record of any one questioning the authority of Aristotle until Galileo's day.

Some of the most precise experimental work on record has been devoted to this question. It is certainly a remarkable thing that however greatly bodies may differ in every respect that can be imagined, they yet behave exactly alike under gravitative action. Bodies of all weights, of all kinds, solid or liquid, hot or cold, transparent or opaque, good or bad conductors of electricity, bodies of terrestrial or of meteoric origin—one and all sink their differences in behavior at the call of gravitation.

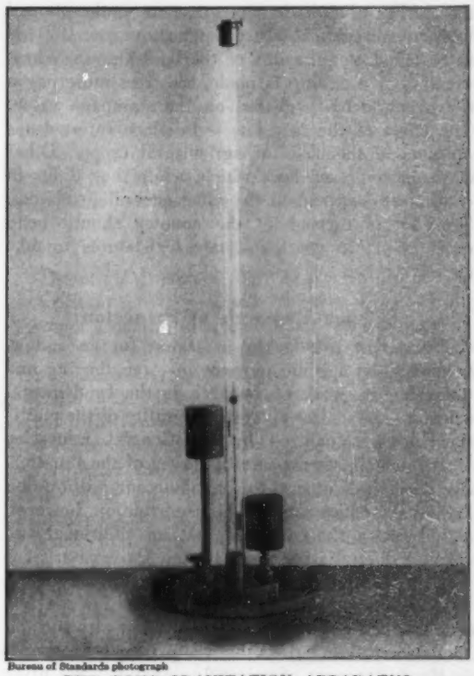


WHEN YOU THROW A STONE

The inner circle represents the earth. The other circle and the ellipses are possible orbits of a missile

Twentieth century experiment has shown this constancy of action to be true to the extent of one part in at least two hundred million. Few laws of Nature have been studied with this precision. This remarkable and exceptional constancy of action has been made by Einstein the foundation stone of his theory of gravitation, which (whatever may be said about it) is by no means to be characterized as commonplace.

Wonderful in its path, wonderful in its speed, the stone is still wonderful when it has lost its motion. Falling, it is an object of amazement to astronomers and physicists; and when it falls into the hands of the geologists and chemists the tale it tells them is equally wonderful.



Bureau of Standards photograph

THE BOYS GRAVITATION APPARATUS

"Every particle of matter in the universe attracts every other particle. . . ."—Newton's Law of universal gravitation

"I am old," it says to the geologist. "Old past all speaking. You men-creatures travel round the world to gaze upon the tombs and temples of Egypt, things of yesterday compared with the stone of which they are made, for I and my kind saw Egypt born. We felt the heavy tread of the mammoth and the hot breath of the sabre-toothed tiger. We lay at the bottom of the sea in the Age of Fishes. Ay, before life was, we were, in substance like as now. Changeless, we have watched the Pageant of Time; unchanging, we shall see the end of that of which we have seen the beginning."

"I am old," it says to the chemist, "yet in your hands I am born into a new life of usefulness. Changeless for ages, I have waited the coming of the master who should know how to use me. All my treasure is freely at your service. Will you build a house, paint a picture, sail the sea or fly the air, I and my kind will furnish you the materials. I am old, yet ever young, for although I change my form I never die."

And to every one of us it says: "Wake! for you walk in Wonderland!"

Our Point of View

Excellent Forest Laws

AT last the state legislatures are passing greatly needed constructive legislation to stimulate the building up of the denuded forest lands of the United States. Hitherto owners of cut-over forest lands have been discouraged from replanting by the fact that local tax assessors were in the habit of increasing the taxes on lands that were replanted with trees. Henceforth such lands are to be taxed on the value of the land alone, until the trees have attained a growth which warrants their cutting for commercial purposes. Thus, under the New York law, any tract of five acres or more which has been planted with an average of 800 trees per acre, or under-planted with an average of 300 trees per acre since 1921, is to be taxed on the value of the land alone. When, eventually, a cutting is made, the trees must pay a 6 percent yield tax based on the stumpage value. The effect of the new law is to place forest crops more upon the basis of agricultural crops. Other states have passed laws which, while they differ in detail, are based upon the same general principles. Tree lovers throughout the country should bend every effort to get their state legislatures to take similar action.

Science Research at Princeton

PRINCETON UNIVERSITY is asking for an endowment for the specific purpose of strengthening and enlarging its work of research in the fundamental sciences. Its claims upon the liberality of the public have been recognized by the General Education Board, which, after a careful survey of the situation, has generously offered to contribute one million dollars to the endowment. This contribution, however, is subject to the condition that an additional two million dollars be secured by the University. The request for this sum is made with the belief that it will appeal not only to those generous friends who have already helped the University, but also to individuals and foundations that are primarily interested in the furtherance of scientific research. We bring this matter before the public under the belief that Princeton has a special claim upon the support of the public because of its unrivaled record in the promotion of fundamental science during the past twenty-five years. The development of Graduate College, the Palmer Physical Laboratory, Guyot Hall, and the addition to the Faculty of a number of men active in research, prove that Princeton has taken a leading part in pure science investigation and training, and it should be remembered that all of this has been accomplished without any adequate endowment for research.

Let us look at some of the concrete facts. It was at Princeton that Joseph Henry developed those discoveries which underlie all dynamo-electric machinery and the first printing telegraph. Here, also, Richardson laid the foundation of the great recent development in radio and multiplex telephony. It was at Princeton that Northrup developed his induction furnace, which promises to revolutionize many processes of metallurgy and which is used in the manufacture of radio tubes and all high-vacuum apparatus. At Princeton the directors of several of the largest astronomical observatories in this country were trained; here, moreover, is the leading authority in this country on the interpretation of stellar conditions in terms of modern atomic physics.

The above facts by no means exhaust the list of accomplishment in fundamental physics at this famous University, and remembering that Secretary Hoover only recently warned the country that we were falling behind in the matter of research in the field of pure science, we feel satisfied that the appeal of Princeton for the necessary two million dollars will meet with an early and generous response.

Safety First

IT is with pardonable pride that the railroad officials of Great Britain are able to announce that last year they carried 1,700,000,000 passengers with only one fatality, and that this one passenger was not killed outright but died from shock due to a poor state of health. There were two preceding years—1901 and 1908—when not a single passenger met death in an accident. The significance of this record is heightened by the fact that, because of the comparatively small size of the country, traffic is very dense; for it is evident that the risk of collisions, whether head or rear, increases with the density of the traffic on any given stretch of line. In the cable dispatch announcing this result a railway official is quoted as attributing the safety of travel "to the careful way the traffic was operated, the large number of safety appliances and the excellent signaling system." We are inclined to think that on this, as on any railway system throughout the world, the most important contributory cause to safety is to be found in the discipline of the railway men, that is to say, in their strict adherence to the rules of operation.

The Navy Metal Dirigible

We venture the prediction that the awarding by the Navy Department of the contract for an experimental all-metal airship will be regarded, in future years, as one of the most important events in the history of aviation. The new craft is purely experimental and is too small to be considered in the same class as the *Los Angeles*, compared with which it is only one-fourth as long and has but one-twelfth the gas capacity. The contract was awarded to the Aircraft Development Corporation of Detroit, which is composed of leading automobile manufacturers. The design of the metal ship has been based upon very thorough and costly experimental work in some of the leading laboratories of the country. No one realizes better than the designers of this little ship that it would be folly to build the new navy dirigibles of six million feet capacity entirely of metal. The necessary data on which to base such a design is not available, but if, as its sponsors confidently expect, the small experimental ship is a success, progress will be made by a gradual increase in size of all successive ships, until the all-metal transatlantic liner is set afloat.

Report on Lake Denmark Disaster

A STUDY of the findings of the Court of Inquiry that investigated the recent wiping out of the naval ammunition depot at Lake Denmark leaves one with the conviction that the Court considers the storing of large quantities of high explosives in the midst of a settled district dangerous and in the future to be avoided. It was the writer's privilege to visit the scene of the disaster. The initial explosion caused by a lightning stroke occurred at Temporary Magazine Number 8, which contained, among other material, some four or five hundred tons of depth-charges. A few hundred feet away was Temporary Magazine Number 9, which contained probably over 1,000 tons of T.N.T. This magazine was not set off by sympathetic detonation from Magazine Number 8, since there was an interval of a minute or so between the two explosions. Climbing the hillside from the roadway one found one's self suddenly on the edge of a vast crater 300 feet long, 200 feet wide and 40 to 50 feet deep. This hollow represented the downward striking energy of the explosion and, as the suddenly liberated gases burst upwards and outwards with a velocity which has been estimated at 30,000 feet per second, they compressed an enormous volume of the surrounding air, which traveled at the velocity of sound and with gradually decreasing pressure, over the surrounding terrain.

Returning to the report, we read that fragments of steel beams were found 5,000 feet away and that the detonation of these two magazines completely destroyed all buildings within a radius of 2,700 feet. As the wave of compressed air traveled over the army arsenal, many thousands of feet away, the wave-like action of the air on the roofs of the buildings crushed them in and left them lying limp, like great stretches of fabric, through which one could see the contour of the piled but unexploded contents below.

The report recommends the establishment of two depots for large quantities of high explosives, located in remote and barren land, one within a thousand miles of the Pacific coast and the other in a similar region within the same distance of the Atlantic coast.

A Fine Record

IF the average citizen were asked to state what institution contributes more than any other to our material prosperity the answers would vary, but whoever should happen to name our railroad system would be close to the truth. Transportation, surely, is the very foundation of our material wealth and well-being.

The war hit our railroads a staggering blow. When the government returned them to their owners the management found them to be in a deplorable condition. The roadbed, track and equipment had been allowed to run down so badly that most of the post-war revenue was absorbed by operating expenses. Fortunately the men at the head of our railroads were able, far-sighted and courageous. Realizing that the very first thing to do was to get the system back into good physical condition, instead of worrying about dividends they turned the earnings back into the properties and gradually brought them up to a proper standard of efficiency. Today the tracks, ties, bridges and structures generally, to say nothing of the equipment, are in as good condition as ever before in the history of the railroads.

How do we know this? It is proved by the fact that during the first six months of this year the average freight train hauled about 9,000 ton-miles every hour as compared with 7,300 ton-miles, which was the average performance in 1920. No finer record than this can be found in the whole history of our railroads. It is gratifying to learn, furthermore, that during these six months the whole operating income was nearly 500,000,000 dollars, which is also a record. This is nearly 5 percent on the total property invested. Compare this with 1920, when the railroads earned only ½ of 1 percent.

Redetermining the Velocity of Light

By Henry Norris Russell, Ph.D.
Professor of Astronomy, Princeton University
Research Associate of the Mt. Wilson Observatory of the Carnegie Institution of Washington

THE stars are beginning to fade in the earliest light of a California dawn and the observers at the great telescopes on Mt. Wilson end their last exposures, and close the long night's work. The summits of the Sierra Madre begin to stand out dark against the slowly brightening sky. But, while most of the work is over, a light shines in one small building on a spur of the mountain, and the attention of the passer-by is attracted by a strange sound which breaks the quiet of the early morning—a shrill note, rising at first in pitch and intensity, and then settling into a sustained scream, resembling that of the familiar warning siren, but more piercing.

The casual visitor—were such passing at this uncrowded hour—might well be perplexed, but the observers of the regular staff, walking back to their sleeping-quarters, say only, "Michelson is having a good morning," for they know that in this unpretentious temporary building, the dean of American physicists is at work on the determination of one of the most fundamental constants of nature, with hopes of attaining accuracy far surpassing any previous knowledge.

Visualizing the Tremendous Speed of Light

The measurement of the velocity of light is nothing new. The world has known for generations that it is 186,000 miles a second—to the nearest round thousand. But science is never contented with round numbers—she desires the most precise determination that it is at all practicable to attain.

In Professor Michelson's present work—which the writer had the pleasure of hearing explained by his own lips a month ago—a beam of light, reflected from a rapidly rotating mirror, is sent to another mirror at a distant station, and returns after a minute fraction of a second to the spinning mirror again, only to find that this mirror has turned in the interval, so that the reflected ray is not sent back to the source as it would be if the mirror were stationary, but in a different direction. This rotating mirror method is a very powerful one for measuring extremely short intervals of time. Suppose, for example, that the distant mirror were a mile away, light would travel there and back in 1/93,000 of a second, hopelessly too short a time, apparently, to measure. But suppose that the mirror were turning at the rate of 500 revolutions a second—a quite attainable speed. In this short time it would have turned through 1/186 of a revolution, or nearly two degrees. The reflected ray is deviated twice as much, or almost four degrees. Run the mirror backwards and the deviation is four degrees in the opposite direction. The difference of nearly eight degrees between the two results can be measured to much less than a thousandth of a degree—which amounts to saying that the "light-time" of 1/93,000 of a second can be measured to less than a ten-thousandth of its own amount.

It is evident that for a complete determination of the velocity of light we must measure three quantities: the distance of the remote station, the rate at which the mirror is turning, and the angle through which the reflected beam is deviated. And, of course, to measure any one of them with the highest precision is hard work. If, however, we could get along by measuring two quantities instead of three, the problem would be much simplified; and Professor Michelson has done this in a very characteristic fashion, by a device as simple as it is effective.

His rotating mirror is many-sided—its cross-section, at right angles to the axis about which it spins, being a regular polygon which, in the apparatus now in use, has twelve sides. All the faces are accurately figured, polished and silvered, so that in one turn of the axis, twelve successive mirror surfaces come into the path of the light. If the mirror can be spun fast enough, it is possible to catch the returning beam of light, not on the surface from which it was originally reflected, but on the next. For example, the present distant station on Mt. San Antonio is some 22 miles from Mt. Wilson. Light takes about 1/4,200 of a second (in round numbers) to make the return journey. If the mirror is spun at 350 revolutions per second (a possible rate) it will make just 1/12 of a turn in this interval. The returning beam will find the next successive face of the mirror exactly where the preceding one was when it started, and will therefore be reflected along just the same path as it would have followed if the rotating mirror had been at rest. For faster or slower speeds of revolution, however, it will be deviated by varying amounts.

With this arrangement, therefore, it is only necessary to find the mirror-speed at which the reflected ray is sent back in just the same direction as from a stationary mirror, and we can then be sure that the light-time is exactly 1/12 of that of a revolution. The word "exactly" is here used advisedly. The twelve successive angles between the faces of the mirror are made as nearly equal as instrumental skill can produce them to the theoretical value of 150 degrees, but since the reflected image which the eye can see is made up of thousands of successive flashes reflected from all the mirror faces, its apparent deviation depends on the *average* of the twelve angles—and this must be *exactly* 150 degrees.

To get a precise determination, therefore, only two things need to be measured—the distance of the mirror on the remote mountain and the rate of rotation of the spinning part of the apparatus.

The Cause of the Scream

The first of these has been found, once for all, by the cooperation of the United States Coast and Geodetic Survey, which executed a special and very precise triangulation for the express purpose. The measurement of the second is accomplished with the aid of a tuning-fork driven by electrical means at a very uniform rate. At every vibration of the fork, a beam of light from a little mirror, attached to one of the prongs, is reflected on to the revolving mirror, and thence to an auxiliary eyepiece. If the periods of vibration of the fork and of rotation of the mirror are exactly the same, the successive reflected flashes will fuse into an apparently stationary image, but if one is going faster than the other by even the minutest fraction, this image will appear to move. (This stroboscopic method is of course familiar.) The rotating mirror is driven by a little compressed-air turbine (which when running gives out the ear-piercing shriek which was mentioned at the start). An assistant, with his hand on the throttle of this turbine, and looking through the eyepiece of the stroboscopic system, can adjust the speed of turbine and mirror so that the images are stationary—that is, so that the period of the mirror is exactly that of the fork. Such an adjustment can be kept satisfactory for only a few seconds at a time, but this suffices; for at such moments—indicated by a suitable signal, Professor Michelson, at the eyepiece in which is seen the image produced by the light which has been to the distant station and back, can make his settings which measure where the reflected ray has been sent.

If the rate of the fork is precisely "right" the mirror would have turned exactly 1/12 of a revolution in the light-time, and this reflected image would be in just the same place as that given by a stationary mirror. Actually, the interval defined by the fork will be slightly too short or too long, and the position of the reflected image a little to the right or to the left. By running the mirror backward (which can be done within half a minute or so) the image is now deviated by an equal amount on the other side of its ideal position. The combination of the two settings suffices to determine with extreme precision just how much longer or shorter the light-time is than the time of one beat of the fork. It remains to find this difference—which varies slightly from day to day with changes in temperature. This is again done by a stroboscopic method by which the fork is compared with a standard pendulum, itself very carefully calibrated.

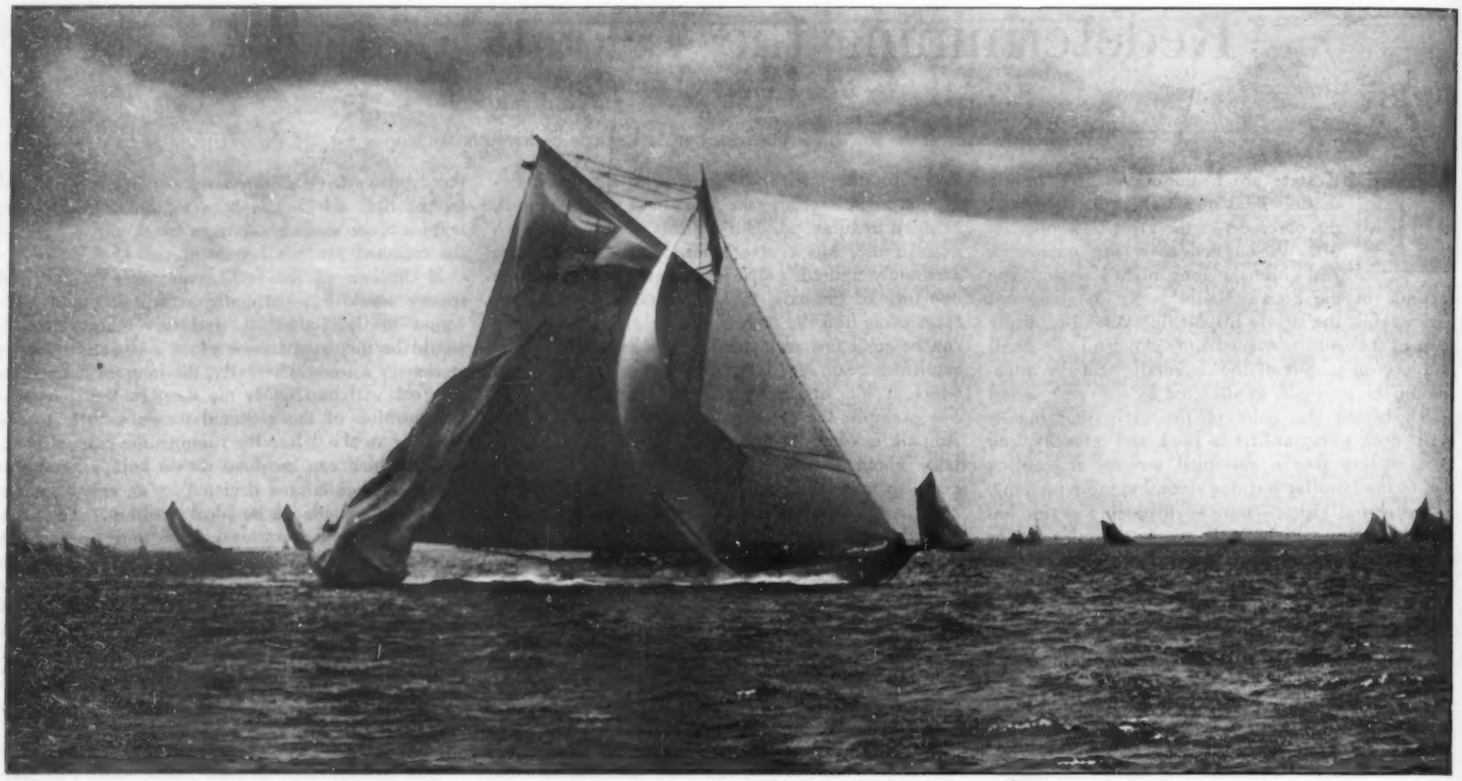
"Such Good Fun"

The original beam of light comes from a military searchlight of the highest power. After passing through a narrow slot, and being reflected from the rotating mirror, it is rendered parallel by a two-foot concave mirror, and sent to the distant station—there to be returned precisely along its course by a beautifully simple optical device. When the rotating mirror is held fixed in the proper position, the return beam is visible to the eye, looking like a brilliant star on the mountain side. By an ingenious arrangement of the optical train, the faint returning beam of light is caught, not on the same face of the mirror as the intense original beam, but on the opposite one—thus avoiding the stray light which would otherwise drown it out.

It is already known that the results of observation on many nights agree so well that we may hope for a final value which will be accurate well within ten miles per second and perhaps a good deal better. But why should months and years of labor be spent in seeking such great precision?

Professor Michelson, speaking recently to a group of students of science, gave two answers. One is that such accuracy may be of practical value in precise surveying. If we want to know the distance of a mountain a hundred miles away within a foot or two, it can be found by a trigonometric survey with the expenditure of great labor and cost, provided that this mountain can be sighted on from at least two others in different directions. When once the velocity of light is known as accurately as Professor Michelson hopes to find it, the distance would be measured in a few nights' work—measuring the light-time—with the same precision. And even in the case of an island visible from but one peak on the main land, his method would succeed when the ordinary one would not work at all.

"But," said Professor Michelson, "I will confess that this is not my main motive. My real reason for wanting to do this is that it is *such good fun.*" Cold type cannot convey the impression which his hearers gained from the flash in the eyes of this veteran of science as he made this confession. But anyone who knows the deep fascination of investigation, and the joy of successfully overcoming obstacles, may understand.



THE *VIGILANT* DISMASTED IN STRONG BREEZE

Photograph taken during trial races between the Vigilant *and the* Defender, *at the moment when the topmast and bowsprit carried away*

The "America's" Cup Defenders

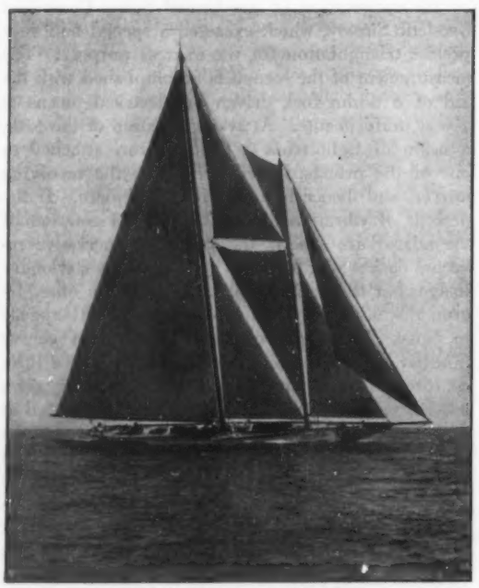
What Has Become of the Famous Yachts Which Have Successfully Defended the Cup Since It Was Won 75 Years Ago

By J. Bernard Walker

SOME three-quarters of a century ago, England was occupied with the great industrial exhibition of 1851 in London. In the previous year, an Englishman had suggested that America send over one of her famous pilot boats to sail against the schooners of England during the exhibition-year regattas. George L. Schuyler and John C. Stevens, together with three or four other yachtsmen, authorized the construction of a boat to be sent across for the English racing. On the appearance of the *America* at Cowes, she created a sensation, so different was she from the English yachts—both in hull and rig. The time-honored English model showed a bluff bow and a fine run. The *America* had a fine hollow bow and her greatest beam was about amidships. Her sails of cotton set very flat and were laced to the boom. The English sails, made of flax, were not laced to the boom and presented a relatively baggy appearance.

In the famous race of 55 miles around the Isle of Wight against a fleet of 17 cutters and schooners, the *America* quickly showed her superior sailing qualities, especially against the wind. She worked her way through the fleet and finished so far in the lead that no other yacht was visible at the finish. This contest was for a cup offered by the Royal Yacht Club. The term "Queen's cup" is a misnomer as applied to the *America's* cup.

The *America*—built of wood—was 95 feet on deck, 23 feet beam and drew 11 feet of water aft. After the race she was sold to Lord John de Blaquière, who raced her for the remainder of the season. He sold her to Lord Templeton, who laid her up in 1854 at Cowes, where she remained until 1859 and suffered severely from dry rot. She was bought as old junk, but was rebuilt on her original lines and put in first-class condition. In 1860, she again changed hands and her owner cruised with her in the West Indies. We next hear of her at Savannah in 1861, where she was fitted out as a blockade runner. Eventually she was sunk, to escape capture, in the St. John's River. Raised by the government, she was sent to Annapolis, where she served for several years as a practice ship for the cadets. In 1870, General V. F. Butler bought her. He raced the old ship and cruised in her; but she was not a match for the improved schooners of later years.



RESOLUTE AS A SCHOONER

Note the new trysail rig between fore and main masts

Finally, the *America* was presented to Annapolis, and today, minus her spars, she lies in a basin at the Academy, where the writer had the pleasure of inspecting her a couple of years ago. Although not a stick of the original ship remains, her lines, with the exception of a lengthened stern, are probably those of George Steers, her original designer.

The *America's* cup was won on August 22, 1851, and 18 years were to pass before an attempt was made to bring it back. The first challenger was Mr. James Ashbury, who brought over his schooner, the *Cambria*—98 feet on the waterline. The British boat was opposed by a fleet of 14 yachts and finished in the eighth position. Nothing daunted, Ashbury challenged for the following year, with the stipulation that the races should be held against a single boat instead of a fleet. This was granted, and when the challenger, with a new schooner, the *Lavonia*, came to the line, there were two boats to meet her (one of which was to be chosen for the race)—the *Columbia*, a light-weather boat, and the *Sappho*, a

powerful boat in heavy weather. In the first three races, he was opposed by the *Columbia* and in the last two by the *Sappho.*

Although James Ashbury was unsuccessful, he did good work for the future of American cup racing, by securing the concession that future races should be between two boats, named months in advance of the races. Five years later, in 1880, the Canadians made an unsuccessful attempt to win the cup with a schooner, and in 1881, they failed again, this time with a sloop.

The year 1885 is memorable because, in that year, the schooner disappeared from the cup contests, which henceforth, for several years, were fought out between the American centerboard sloop and English deep-keel cutter. Sir Richard Sutton had challenged with his racing cutter, the *Genesta.* To meet her, Edward Burgess of Boston designed the sloop, *Puritan,* 81 feet 1½ inches water line, beam 22½ feet, draft 8 feet 8 inches. The *Genesta,* narrow and deep, was 81 feet 7½ inches on the waterline, 15 feet beam, and 13½ feet draft. The broad-beamed, shallow, small-displacement centerboard was too fast for the narrow heavy-displacement cutter. The cup remained in this country.

The Cutter Type Is Adopted

Subsequent to the races, the *Puritan* was changed to a schooner for cruising; then was sold to the Portuguese, who carried natives from Cape Verde to New Bedford for the fishing season. Remarkable to relate, this famous craft is still afloat and doing good service as a motor fishing boat, taking parties out for deep-sea fishing off the Atlantic coast.

The following year—1886—Lieut. William Henn of the Royal Navy brought over another typical English cutter—the *Galatea,* built of steel and carrying 80 tons of lead in her keel. Her length on the waterline was 86.80 feet, beam 15 feet, draft 13.50 feet. To meet her a group of Boston yachtsmen, headed by General Charles J. Paine, built a Burgess-designed and improved *Puritan,* which was named *Mayflower.* The *Galatea,* which was more cruiser than racer, was inferior to the *Genesta* and the American sloop had no difficulty in disposing of her by wide margins. The *Mayflower,* like the *Puritan,* subsequent to the cup races was changed into a cruising schooner and was a familiar figure for several years in yachting circles. This fine yacht was destined for a tragic end. Shortly before the World War an expedition of Harvard men sailed with her to the West Indies, were struck by a hurricane and abandoned her. The *Mayflower* survived the storm, was picked up by West Indian natives and taken to one of the islands, where dry rot and the elements ultimately destroyed her.

THE *RESOLUTE* UNDER SLOOP RIG
She has just come around on port tack. Note the wake

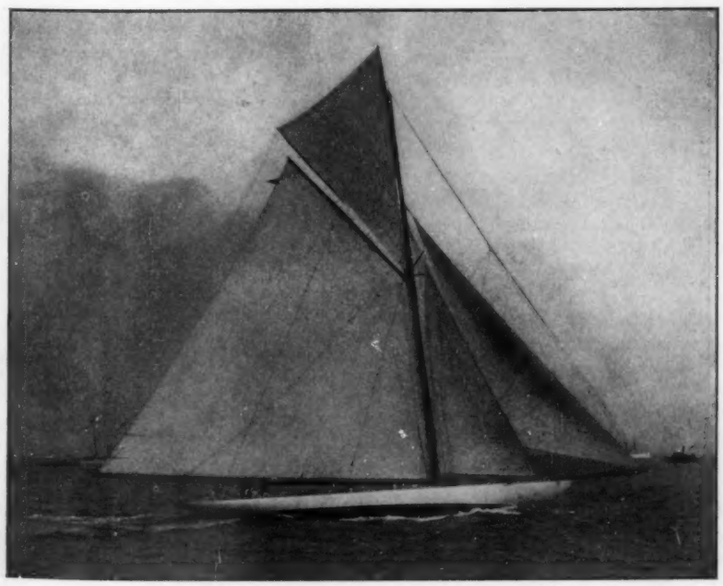
The quest of the *America's* cup was earnest and continuous in those days. The following year, a syndicate of Scotchmen challenged with a handsome steel-built cutter, the *Thistle*—86.50 feet on the waterline. The British had changed the yachting rules, and taken off the heavy penalty on beam. Hence, the *Thistle* showed the unprecedented beam, for an English cutter, of 20.2 feet. For the third time, Boston, under that brilliant yachtsman, General Paine, came to the front with a Burgess-designed steel, centerboard sloop, the *Volunteer.* The *Thistle,* as her designer Watson afterwards admitted, was too much cut away in her forward sections. She could not point up with the *Volunteer* and was badly beaten. The *Volunteer,* after the races, was changed to a schooner and was used as such for many years by J. Malcolm Forbes. Subsequently, after being used as a fishing schooner, she was broken up.

Six years intervened before Lord Dunraven, an ardent, experienced yachtsman, challenged, in 1893, with his Watson-designed cutter, the *Valkyrie II.* This contest was important for the fact that it brought Herreshoff into the field as a designer of cup defenders, and from this time on, the cost of cup yachts mounted to extraordinarily high figures. The new Herreshoff boat, the *Vigilant,* was 86.19 feet waterline, 26.25 feet beam, 13.5 feet draft and she carried the typical American centerboard. She was built of bronze plating on nickel-steel framing and carried a crew of 60 men. In these races, for the first time, a cutter beat a centerboard sloop to windward, and although the *Valkyrie* lost the series, it was evident to yachtsmen that the day of the centerboard sloop was over and that future defenders would embody the deep keel and outside ballast of the cutter type. The *Vigilant* subsequently was changed to a yawl and raced successfully for many years under that rig before being broken up for her lead and bronze.

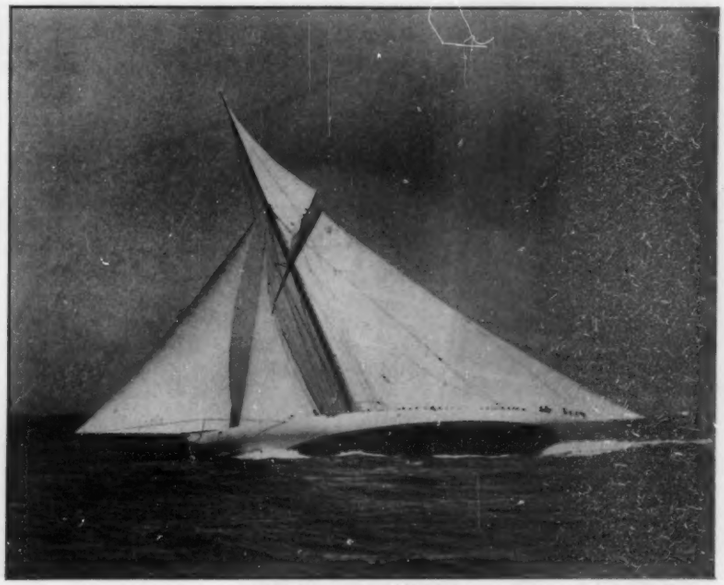
"Defender" First Deep-keel Boat

Two years later, in 1895, Lord Dunraven appeared on the Sandy Hook course with the *Valkyrie III,* which showed the great beam, for an English cutter, of 26.20 feet and carried a sail spread which was even greater than that of the American defender. To meet her, a syndicate of New York Yacht Club members built, from Herreshoff designs, a remarkable boat, the *Defender.* She marked the end of the centerboard sloop and the entrance of the American cutter. In her deep keel (19 feet draft) she carried 85 tons of lead. Her framing was nickel-steel, her under-water plating was bronze, and a light aluminum alloy was used on her topsides, deck, and deck beams. She was successful in retaining the cup, but subsequently her aluminum-alloy parts deteriorated so rapidly that she was sent to the break-up yard. Her last sail was her finest. William Butler Duncan sailed her from New London to City Island in smooth water under the lee of Long Island in a gale of wind. The boat was under mainsail, foresail, jib and jib-headed topsail. The wind was southeast, and since she was to be broken up, Mr. Duncan was willing to take a chance on her spars in an effort to see what the *Defender* could do. The reach of 85 sea miles was covered at an average speed of 13.86 knots! The *Defender* was broken up at Hawkins' Yard, City Island, in 1901.

The next series of races, which opened in 1899, introduced a new figure in international competition



THE *COLUMBIA,* TWICE DEFENDER OF CUP
The most successful of the famous Herreshoff-designed cup yachts



THE MIGHTY *RELIANCE*
Most extreme and powerful ninety-foot racing yacht ever constructed

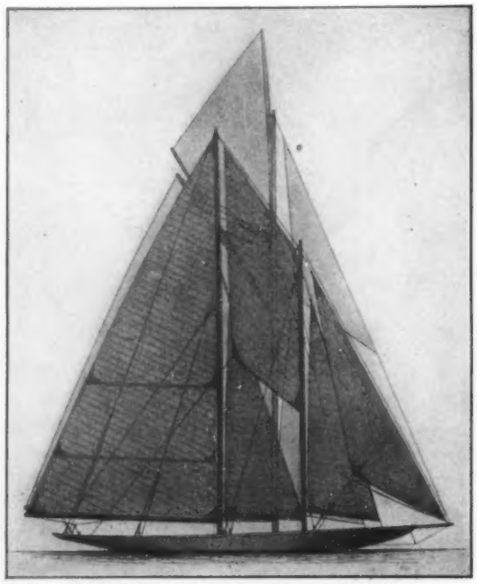
in the person of Sir Thomas Lipton, who was destined to make four separate and gallant attempts to win the *America's* cup. Cup racing had become an exceedingly expensive pastime and Sir Thomas, a man of great wealth, was able to give his yacht designers a free hand so far as expense was concerned. His first yacht, the *Shamrock*, designed by Fife, 87.69 feet on the waterline, showed the characteristic beauty which marks Fife's boats. To meet her, a New York Yacht Club syndicate launched, from Herreshoff's designs, a beautiful bronze boat, the *Columbia*, 89.66 feet long by 24 feet beam by 19.75 feet draft, which achieved a rather easy victory over the Fife cutter. The *Columbia* spread 13,136 square feet of sail.

"Shamrock II" Dangerous Challenger

Undismayed by his failure, Sir Thomas returned in 1901 with the *Shamrock II*, which stands in the records today as the most dangerous challenger in all the 75 years covered by the cup contests. Designed by Watson, after exhaustive tests of various models in the towing tank, this bronze boat, 89.25 feet on the waterline, spread no less than 14,027 square feet of canvas. To meet her, Herreshoff designed the *Constitution*, which, although she followed the model of the successful *Columbia* rather closely, failed to come up to expectations—so much so that the *Columbia* was chosen to meet the *Shamrock II*. In the races, the *Shamrock II* proved to be the faster boat on the wind and running. In reaching, the *Columbia* was the better boat.

Unfortunately, the skipper and crew of the *Shamrock II* failed to get the best out of her and she was beaten by close margins by the *Columbia*. Captain Barr, who sailed the *Columbia*, told the writer that the *Shamrock II* was actually the faster boat, and that had she been properly handled, would probably have taken back the cup. She never left this side of the water, but was broken up at Robbins' Yard, Brooklyn, New York. The *Columbia* was laid up at Hawkins' Yard, City Island, where she shared the same fate in 1915.

Two successive defeats and a total expenditure of over 500,000 dollars apparently did not discourage Sir Thomas, for in 1903 he made his third appearance at Sandy Hook with a new challenger, the *Shamrock III*—a handsome and beautifully modeled ninety footer designed by Fife. To meet her, Herreshoff designed the *Reliance*, by far the largest and most powerful cup yacht ever produced, or likely to be built, in the future history of America's cup races. With a waterline of approximately 90 feet, she had a beam of about 26 feet. The *Reliance* was a great departure. Her hull was of the scow type, measuring 142 feet on deck; she drew about 20 feet, and carried in her keel not less than 100 tons of lead. Above this hull was a sail-spread of over 16,000 square feet, as against a sail-spread for the *Shamrock III* of about 14,000 square feet. The *Shamrock III* showed ability to hold the *Reliance* to windward under certain conditions of wind and sea, but she was outclassed in reaching and running, and the *Reliance* scored an easy series of victories. The great yacht was laid up immediately after the races and was broken up at Robbins' Yard, Brooklyn, in 1914.



VANITIE AS SLOOP AND SCHOONER

Both drawings are made to the same scale and they show the smaller spread of canvas of the Vanitie *as a schooner*

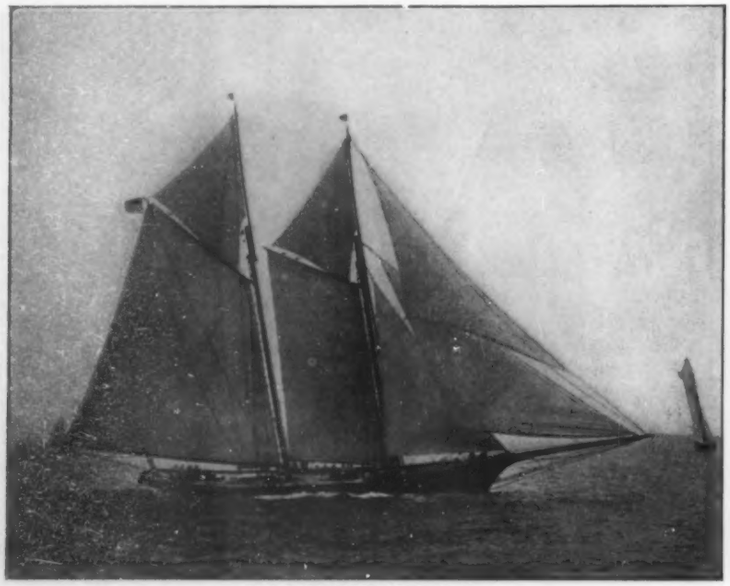
Just here, mention should be made of the great cost of building, tuning up and racing a modern cup defender. The total cost of the *Reliance*, including her designer's commission, the construction of the hull, rigging, spars and the seven suits of sails which she carried, the hire of tenders to house the crew, the hire of tugs, et cetera, ran up to 410,000 dollars. The cost of the *Independence*, built by Lawson of Boston for cup defense, although she was only three months in commission, was 205,000 dollars. Each of the two mainsails for this boat cost just under 3,000 dollars. Not much of these great sums of money was recovered. The hundred tons of lead from the *Reliance* brought 10,000 dollars and the 30 tons of bronze from her hull, 3,300 dollars. Her sails were sold for 3,600 dollars, her mast and spars for 1,000 dollars and her blocks and other gear for about 500 dollars, making a total recovery of 18,400 dollars out of her total cost, for the whole season, of 410,000 dollars.

In 1914, Sir Thomas Lipton brought over the *Shamrock IV*—a smaller yacht, 75 feet on the waterline and of composite build. She was beaten by the 75-foot bronze boat, *Resolute*, in a series of races which was held soon after the World War. The *Resolute* has been re-rigged as a staysail schooner and is racing this season against the *Vanitie*—a Gardner boat which was built for the defense of the cup and sailed some spirited contests against the *Resolute*. Thus far, in the present season's races, the *Vanitie* has shown a decided superiority over the *Resolute*.

Will the Schooner Come Back?

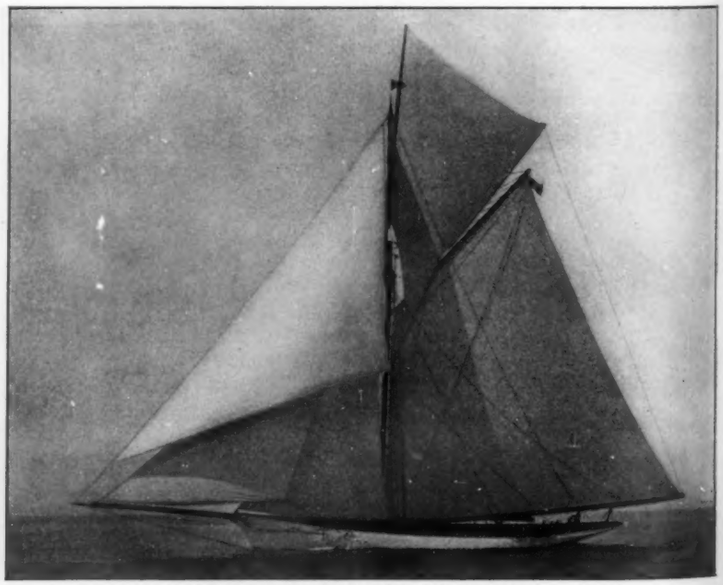
As to the future of the *America's* cup—whether it will continue to be the object of fierce yachting rivalry, or whether it will rest, seemingly forgotten, in the custody of the New York Yacht Club—who can tell? It is our hope that the action of Sir Thomas Lipton in challenging with a 75-foot instead of a 90-foot yacht will have a beneficial effect because of the lower cost of the smaller vessel; also, we rather expect to see a revival of the schooner in future cup races, particularly in view of the great interest which is being shown in the schooners because of the introduction of the new staysail rig.

The preference shown by racing men for the cutter or sloop over the schooner, has been due largely to the superior ability of the former when sailing to windward. It has been difficult to bring the old gaff foresail of the schooner snugly up to the wind. Several of the crack schooners have substituted, this year, a staysail rig between foremast and mainmast. For windward work, this is more effective than the old gaff-headed foresail. There is no finer sail for windward work than a well-cut jib, and the staysail rig is based partly upon that fact and partly upon hints from aeronautical laboratories as to the action of the air on airfoils.



THE FAMOUS *AMERICA*

Shown with a later and improved rig, racing against more modern schooners



THE BURGESS-DESIGNED *VOLUNTEER*

The first defender built of steel. She defeated the Watson-designed Thistle

The Salvage of the "S-51"

A Feat of Engineering Without Precedent in Naval Records

By Edward Ellsberg, Lieut.-Commander, Construction Corps, U. S. N.
Officer directly in charge of the salvage and diving operations

THE *S-51*, which has recently been recovered from the bed of the sea where she had lain in 132 feet of water for the greater part of a year, is one of a class of four similar submarines. She has the following dimensions: Length, 240 feet; beam, 21 feet, 11½ inches; surface displacement and speed, 1,001 tons and 14.2 knots; submerged displacement and speed, 1,230 tons and 9 knots. She was practically new, only about three years old.

She was sunk at 10:24 P.M., September 25, 1925. At that time she was operating as a surface vessel, course about northwest, speed 11.5 knots. She was struck 30 feet forward of the conning tower on the port side by the *City of Rome*, the angle of impact being 40 degrees abaft the port beam (actually measured in drydock from trace of stem and forefoot of the *City of Rome* in the *S-51's* side). A hole 13 feet deep and 2½ feet wide was made at frame 54, coming about the middle of the battery room, which is the main living compartment.

Admission of a large volume of water forward caused the *S-51* to trim deeply by the head, and it appears that she planed under before she actually took in enough water to sink her. She disappeared in less than one minute, still going ahead with considerable speed, and struck bottom in 132 feet of water, bow first, with such force as to buckle up the shell plates completely around her hull at bulkhead 43, this being the point where she changed from single to double-hull construction.

Dove Six Feet into Hard Clay

At the time of collision, all interior doors were open for ventilation purposes, in accordance with the operating design of the boat. All hatches were closed, except the conning-tower hatch. All valves from the external ventilation main to the compartments were open.

The crew were all drowned with the boat, with the exception of three men who were asleep in the battery room at the instant of collision. These men escaped, and being clothed only in their underwear, managed to keep afloat. The captain, two other officers, and two seamen, who formed the bridge watch, were on deck as the vessel sank; but all were drowned, as they were unable to keep afloat in their heavy clothes until the *City of Rome* could get a boat over. Two other seamen from the inside of the boat also escaped, but were drowned outside. Twenty-six members of the crew, including three officers, were drowned inside the boat, their bodies being found in every compartment. While the boat was sinking, it is evident that the crew inside did their utmost, as the bodies were generally found at their stations, and in many cases, still grasping valves or controls. Owing to the rush of water, no doors could be closed, and the boat was found completely flooded.

As discovered (by an oil and air slick) the next morning, the *S-51* was fourteen miles to seaward of Block Island and about fifteen miles southward and eastward of Point Judith. She was resting at an angle of 13 degrees to port, and buried about six feet deep in a bed of hard clay, mixed with some sand. The *S-51* was headed practically north (350 degrees).

As a desperate measure, in case life existed inside the boat, an attempt was made to lift the stern with derricks hired from a wrecking company. Five days elapsed before a sea prevailed that was calm enough for the wrecking company to allow their derricks to leave the Harbor of Refuge at Point Judith. The two derricks hooked to wire slings around the stern, took their maximum lift (250 tons), failed to budge the stern, were cast loose, and hurried back to harbor. The navy then undertook to salvage the vessel with its own facilities.

Salvage operations were under the command of Admiral Plunkett, Commandant 3rd Naval District, at New York. Captain E. J. King, Commander Submarine Base, New London, was in command of the salvage squadron, and was Officer in Charge of salvage operations. Lieutenant-Commander E. Ellsberg, Construction Corps, was Salvage Officer, and directly in charge of all salvage work and diving operations.

The salvage squadron consisted of the *U.S.S. Falcon*, a minesweeper specially fitted for diving and salvage work, equipped with high and low pressure air compressors, a recompression chamber, wrecking pumps, both steam and electrical, and special bitts and chocks for handling weights. The *U.S.S. Vestal*, a repair ship, fitted with shops of every nature, manufactured all special equipment needed, berthed the extra personnel, and acted as a portable breakwater. Two seagoing tugs, the *Sagamore* and the *Iuka*, were used for miscellaneous towing, but mostly as portable moorings.

Photograph by International Newsreel

THE FATAL WOUND

In this photograph is shown the port side of the S-51, *from about the angle at which the* City of Rome *overtook and cut her down. The swift inrush of water doomed the ship*

The *Falcon* planted seven heavy anchors around the wreck, each with a mooring buoy, to which buoys the *Falcon* moored herself. The *Vestal* normally apchored to windward to break the seas. The *Sagamore* and the *Iuka* were normally anchored directly to windward and lines run to them from the *Falcon*, to assist in holding in position. In this manner, and by this unprecedented use of ships as breakwaters and moorings, the *Falcon* was able to hold position and send down divers in rough weather, with wind blowing force 5. Otherwise, diving days would have been so scarce that it is doubtful if anything could have been done. The location was in the open sea, out of sight of land, and in a position notorious for continued bad weather. This reputation was found to be fully justified.

The first endeavor was to seal up undamaged interior compartments, these being the control room, the engine room, the motor room, and the tiller room (these last two were handled as one). In each case, the compartment was wholly isolated, the doors closed, all valves closed, and the compartment made an independent unit. This involved an immense amount of difficult and dangerous work inside the boat on the part of the divers.

Certain valves in the ventilation system required special treatment as they would not stay closed under an internal pressure. To seal one of these valves, a section of heavy copper pipe, nine inches in diameter, was unbolted under water by the divers and a blank flange put on. To close off two others, a 1¼-inch hose was screwed into the valve body in each case, and cement was run under pressure from the *Falcon* through 250 feet of hose into the valve. A mixture of two parts of neat cement and one part of fresh water was used. This, experiment showed, would flow and would safely harden under salt water. The cementing operation worked very successfully. The cement hardened quickly and the valves thereafter showed no leakage whatever.

How Buoyancy Was Obtained

The hatches to each compartment, which were unable to resist internal pressure, were removed and special salvage hatches installed by the divers. These were held in place by a strongback designed to take the full internal pressure. Each hatch was fitted with blowing connections for compressed air, test connections to show the level of water in the compartment, and a four-inch spillpipe which extended to the bottom of the compartment and through which the water was expelled. Each spillpipe had attached to its lower end a non-return valve which prevented water from leaking back, and also acted as a relief valve for the air as the submarine rose to the surface.

The salvage hatches weighed 700 pounds each. Their installation by the divers was a difficult job. It would have been an impossible one if the divers had not been provided with special davits, booms, and chain falls, all made on the *Vestal*, which were first secured to the *S-51*, so as to plumb the hatch trunks. The hatches were then lowered from the *Falcon* to the deck of the *S-51*, where the divers hooked the hatches with chain falls from the special davits and thus handled them. Aside from the four main compartments, mentioned above, fourteen smaller compartments (ballast and fuel tanks, et cetera) were sealed up and used for lifting.

In many of the above tanks it was impossible to get at the interior valves or valve operating gear. To utilize these tanks, a hole was burned in the lowest point of the tank, using the underwater torch designed by the writer. An air hose was pushed through the hole so burned. On turning on the air, the water was forced out the same hole till the compartment was completely dry. The hole later served as a vent for the escape of air as the vessel rose,

and thus prevented disrupting the tank by subjecting it to undue internal pressures. In the manner stated above, a total buoyancy of 527 tons was obtained.

To provide the remainder of the buoyancy required, as well as a margin for contingencies and a reserve, eight pontoons were provided, each with a net lift of 80 tons. These pontoons were steel cylinders, 32 feet long, 13 feet in diameter, sheathed outside with four-inch yellow pine planks. Each pontoon was built like a section of a submarine, and was suitably stiffened with frames and girders, being designed to resist the full internal bursting pressure in case of a sudden rise to the surface. Through the vertical center of each compartment was run a 12-inch hawsepipe, riveted to a heavy casting, top and bottom, with eight internal brackets to distribute the load from the hawsepipe castings to the pontoon itself. Two and one-half inch anchor chain, threaded through these hawsepipes, formed the cradle for the boat.

Cutting Tunnels With Water

Each pontoon was fitted with a six-inch flood valve at the bottom of the vertical bulkhead on each end. This flood valve was operated by a rod reaching to the top of the pontoon, easily accessible to the diver. Alongside the flood valve was a six-inch spring-loaded relief valve, set to blow at an excess pressure of 10 pounds. On top of the pontoon, each compartment was fitted with a one-inch connection for the blowing hose, located near the center bulkhead, and a three-quarter inch vent connection located near the end bulkhead.

The buoyancy conditions required that six of the pontoons be located in the forward half of the boat, where the internal buoyancy was slight; the other two pontoons were located at the stern.

At the extreme bow and stern, the submarine was clear of the bottom. To get the chains through here, the divers first passed small manila reeving lines under, two lines being required for each pair of pontoons. To get these reeving lines under the *S-51* for the other locations, tunnels had to be dug. The tunnels were cut by washing away the clay with a stream of water from a firehose. On account of the depth and the hard bottom, no other means was available. It was found that 1½-inch hose with 60 pounds pressure was as much as a diver could hold. Under these conditions, it took two weeks work to run one tunnel under the submarine. The second tunnel was run much faster, as a new nozzle, which eliminated all pressure reactions, was utilized on this tunnel. With the new nozzle, a diver was easily able to manage a stream of water from a 2½-inch firehose under 200 pounds pressure, and with the resulting stream of water, the second tunnel was cut through in two days.

The pontoons weighed 40 tons each, and were difficult to handle. If one broke free and fell on the submarine, it would crush it in. Such pontoons had never before been used except in shallow water, where they could easily be dropped into position. Here they required to be lowered to a considerable depth and placed exactly, especially in the forward half of the submarine, where a clearance of only eight feet could be allowed between pontoons in a fore and aft direction.

It was found that as a pontoon was flooded down enough so that it just submerged, it lost all longitudinal stability and invariably went down one end first if an attempt was made to lower it. Furthermore, under the increasing pressure, more and more water was forced through the flood-valves into the pontoon, which thereby increased in weight as it sank until it broke the lowering lines, unless these were able to take the full weight of 40 tons.

To overcome these troubles, it was found after some calculation and checking, that at a negative buoyancy of 10 tons, the internal water-plane was sufficiently reduced so that the pontoon could be kept level, provided it was lowered evenly at both ends. To prevent any increase in weight during lowering, the pontoon was held just below the surface for a period long enough to flood it to a weight of ten tons; after which the air vents were closed off to prevent the escape of air and the flood valves were closed tightly. The pontoon was then lowered and acted as a fixed weight. To lower the pontoon, a manila line four inches in diameter was secured to each end of it by a pelican hook. These two lines were strong enough to take the full load, if it should accidentally be applied.

To get the 2½-inch chains, that passed below the hull, from pontoon to pontoon, into position, a manila line one-half inch in diameter was first run under the submarine by the diver, both ends of the line being carried to the surface. A manila line 1½ inches in diameter was next hauled around by the *Falcon*, using the small line to haul. With the 1½-inch manila line as a hauling line, a one-inch plow-steel wire cable was hauled through. The wire cable had a breaking strain of about 35 tons. Using this to haul, a 2½-inch iron chain 90 feet long and weighing three tons, was lowered down on one side of the submarine and hauled under the keel until the chain was equalized on both sides.

With two chains in position, and a wire cable running to the surface from each end of each chain, the lowering of the pontoons was begun. Assuming that the starboard side pontoon was first lowered, the wire cables on that side were threaded through the two hawsepipes of the pontoon, and all four wire cables then hauled moderately taut to hold the chain cables vertical above the submarine. The slack in the manila lowering lines was taken in, and the pontoon vented and flooded until it submerged about four feet. Here it was held by the lowering lines until it weighed about 10 tons, when all vents and floods were closed. The pontoon was then lowered gradually and evenly until it had descended about 90 feet. At this depth it was held while two divers went down and landed on the pontoon. If the pontoon was in proper position (as it always proved to be), it was gradually lowered under the diver's direction until the chains showed through the hawsepipes. When sufficient chain showed through, the pontoon was held again. Here the diver burned a stud out of the chain link just above the hawsepipe (in some cases the stud was removed before lowering the chain) and inserted a 3¾-inch by 3¾-inch nickel-steel bar 40 inches long which spanned the hawsepipe and passed the load from the chain to the pontoon. Over a span equal to that across the hawsepipe casting, 18 inches, one of these bars was successfully tested to a load of 235 tons before reaching its yield point.

Shift in Buoyancy Proved Troublesome

The diver locked this bar in position in the chain link by two long one-half inch steel bolts which passed through holes in the nickel-steel bar, one hole each side of the link.

Having secured his chains, the diver was lowered with the pontoon to the bottom where he opened the flood valves, let go the hauling wires on the chains, and cast off the lowering lines.

When the second pontoon of the pair was lowered, the process was varied; but limitations of space prevent a detailed description of the variation.

Having lowered and secured eight pontoons in the manner stated, they were leveled off in their afloat positions over the submarine and then lashed in place with one-inch wire cables to prevent their slipping in the raising process.

As submarines have small longitudinal stability while submerged, a transfer of a ton or two of water from bow to stern will create a large change in trim. In this case, where the internal buoyancy of the pontoons could not be accurately checked while blowing, and considerable free water existed even in the compartments blown dry, it was out of the question to attempt to bring the submarine up both ends together, as one end was bound to become buoyant and rise before sufficient buoyancy could be given the other end. It was decided to bring the submarine up stern first, and all pontoon arrangements and lashings were put on in accordance with that design, together with taking advantage of all structural features of the submarine to prevent the pontoons slipping aft.

All work was completed June 21, 1926; the submarine and the pontoons were partly lightened in preparation for the final raising on June 22.

Why She Was Worth Salvaging

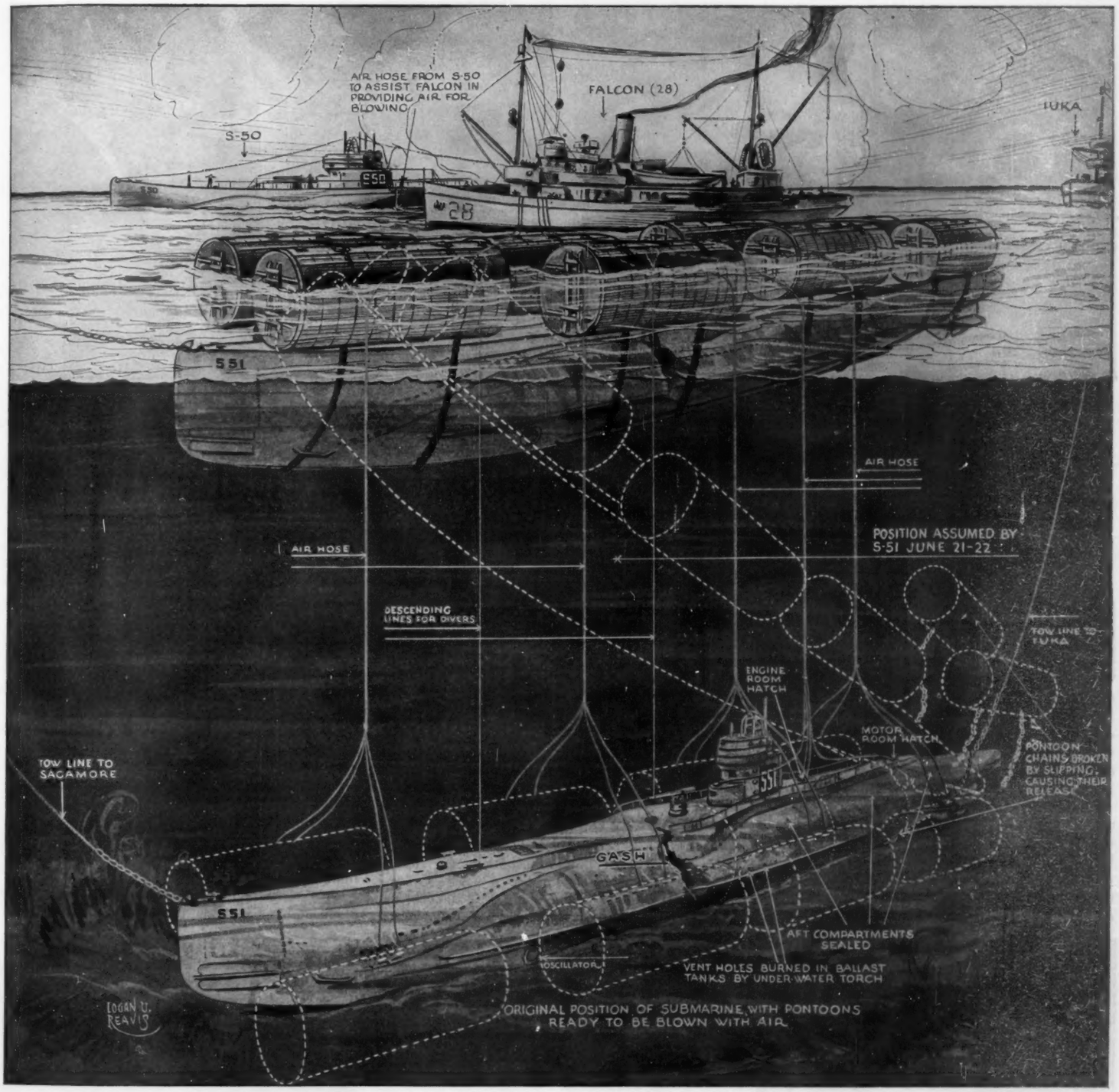
A storm broke on June 22 and prevented the raising attempt. The effect of the seas on the bottom apparently rocked the lightened submarine enough to break the bottom-suction and tear the bow loose. While the *Falcon* was preparing to unmoor and run for shelter, the *S-51's* bow came up almost under her, and the first four pontoons showed above the surface. These pitched heavily in the storm and started to batter each other to pieces. Under these circumstances, an attempt was made to lift the *S-51's* stern and get away. However, when the stern pontoons had gained considerable buoyancy, their chains slipped forward a few feet and hit the vertical keel, where they snapped under the impact and freed the pontoons which floated up. As it was then impossible to lift the stern, the valves were opened on the pontoons at the surface and the bow sunk to avoid further damage from the storm. This was a hazardous undertaking; but the men tackled it willingly and the job was successfully carried through.

The damaged pontoons were raised, towed 15 miles to Point Judith, repaired, and towed back to the *S-51*. In three successive days all six pontoons were again lowered and secured to the submarine.

All work was again completed about noon on July 5, 1926. At 12:17 P.M., the blowing process started, air being sent to the engine and the motor rooms first, then to the control room. Air was next admitted to the stern pair of pontoons, and at 2:06 P.M., while the stern pontoons were being blown, the stern rose. All air was then concentrated on the forward set of six pontoons. These rose at exactly 3 P.M., bringing up the bow.

The *S-51* was then started for New York, 150 miles away. The first 20 miles of the tow were through the open sea, in moderately rough weather, which caused no special trouble. Two tugs, the *Iuka* and the *Sagamore*, towed in tandem ahead; the *Falcon* towed about 150 feet astern of the *S-51* for the double purpose of serving as a jury rudder and to supply air. While no leaks developed, no chances were taken and the *Falcon* constantly kept pumping air to all compartments and all pontoons.

Long Island Sound was safely navigated, and the tow passed through Hell Gate at high water slack. The pilot endeavored to pass between Man of War Reef and Ferry Reef, instead of sticking to the main channel. As a consequence, the *S-51* was stranded on Man of War Reef at the top of the high tide. The impact broke the chains on the second pair of pontoons from the forward end, which pontoons floated up and drifted away. As the tide dropped, the position of the *S-51* became precarious, as she listed more and more, finally resting about 30 degrees to starboard. By resinking the other forward pontoons until they were out of sight below the water and shortening their chains, all the reserve buoyancy in them was brought into action. When the evening high tide arrived, these pontoons were



HOW THE NAVY PERFORMED ITS GREATEST FEAT OF SALVAGE

The S-51, weighing 1,200 tons, lay on the bottom in 132 feet of water, 14 miles from the nearest land and in very exposed and rough waters. Because of the gash in her side, the forward half of the boat could not be sealed. The after half was sealed and the water blown out. Eight pontoons, each with an 80-ton lift, brought the boat to the surface

again blown dry and just managed to float the *S-51* free of the reef. She arrived about 11 P.M. at the Navy Yard and was docked next day.

Here the vessel was examined. The bodies of eighteen members of the crew were removed. (Nine others had been previously removed by divers.) All bodies were promptly identified.

Both hull and machinery were found in good shape with no corrosion or electrolytic action from submersion.

It is estimated that 600,000 dollars will be required to repair the hull and overhaul and replace the machinery, of which cost about two-thirds is for the machinery. As the vessel cost nearly 3,000,000 dollars and is only three years old, reconditioning is obviously a good business proposition.

All told, 30 divers worked on the salvage job, although 24 was the maximum number present at one time, and only thirteen were in condition to work at the end. The others were incapacitated by "bends," pneumonia, and physical exhaustion. However, no diver was ever hurt by an accident. All the divers employed have now recovered and are in good health, although some can never dive again.

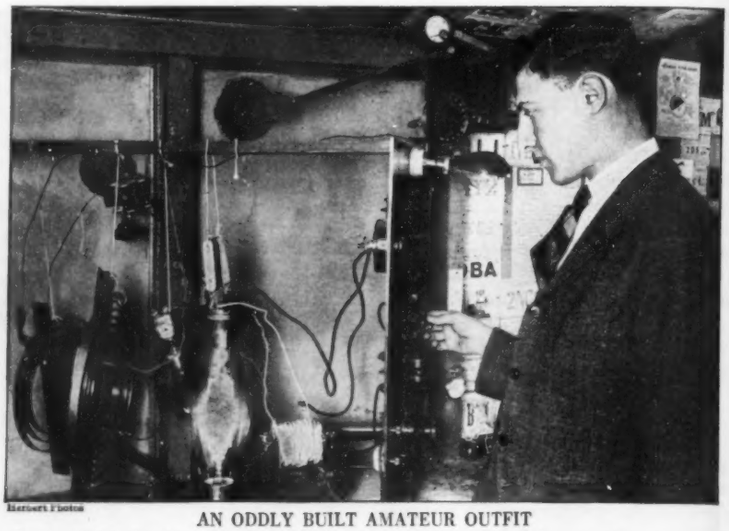
The operation was exclusively a navy undertaking, handled throughout by naval personnel, with all divers recruited from existing navy divers, or specially trained for this particular job by a diving class run last winter at the Brooklyn Navy Yard.

The job as an engineering undertaking is without precedent. It is the only occasion on which a submarine has been brought up by any nation from deep water in the open sea. This was also the only time in which submersible pontoons have been used in deep water; and, finally, the 150-mile tow of a submerged submarine in a pontoon cradle was unique both from a salvage and a seamanship point of view.

The engineering skill and the unconquerable spirit of the officers and men who made the job a success make this operation stand out as one of the brightest spots in the record of the Navy's peacetime activities.

STATION 2NZ's LONG-RANGE TRANSMITTER

Contact has been established between 21 different countries since the beginning of 1926 with this installation located in New York City. The operator communicated with the Byrd Polar Expedition for 17 days



AN ODDLY BUILT AMATEUR OUTFIT

Station 2BRB, Brooklyn, New York, uses a German tube. All of the transmitter parts are suspended from a stick. The owner is E. M. Glaser, former manager of the Hudson Division of the American Radio Relay League

Amateurs Find Marconi Was Right

Short-wave Possibilities and Beam Radio Were Outlined by Inventor in 1922

By Orrin E. Dunlap, Jr.

WHEN Guglielmo Marconi visited the United States in June 1922, he predicted that the advancement of science would be so rapid during the ten years to follow that the powerful transatlantic stations then in existence would become obsolete. He emphasized the fact that he believed the development of vacuum tubes for transmitting purposes would replace the more expensive and cumbersome high-frequency alternators and that short wavelengths were a field of vast possibilities.

Senator Marconi said that he looked to America to aid in the development of short waves, a field which his engineers were delving into at that time. He explained that he had ceased his experiments with short waves twenty-five years previous, because the demand for safety of human life at sea made it desirable to produce long-wave equipment which could be used for broadcasting at sea and for flashing SOS calls by stricken ships. He said that his investigations proved the value of waves from one to fifty meters in length and that he was perfecting a radio beam or "searchlight" method of communication.

Four years have passed since Marconi sailed out of New York Harbor on board his yacht *Elettra* bound for England. In the time that has elapsed since then, radio development has followed the trend Marconi outlined.

Short Waves Developed in Four Years

The British Imperial Empire is linked together by Marconi short-wave beam transmitters, the "baby" of which he demonstrated before a meeting of the Institute of Radio Engineers in 1922. Many of the high-power, long-wave commercial and naval transmitters are supplemented by comparatively simple short-wave installations, and thousands of American amateurs, many of them boys in high school, operating home-made, short-wave transmitters in the attics of their homes, are talking around the world with less power than is required to operate an electric toaster or flatiron.

Four years ago many were amazed by Marconi's predictions regarding short waves, but his reputation as a conservative scientist led American amateurs to have faith in his statements. They knew that he had never made an announcement until he was absolutely sure and that he had never had to withdraw a statement as to his progress. When he first spanned the Atlantic with a radio signal on December 12, 1901, he did not issue a statement to the press until two days later.

American youth had confidence in Marconi and his remarks in 1922 spurred them to experiment with short waves, so that today the ether's channels below 80 meters are most popular in the amateur realm. Because it is more economical, commercial agencies are also adopting the short waves for long distance communication but the amateurs are credited as the pioneers of American short-wave wireless!

Amateur station 2NZ in New York City, owned and operated by E. S. Strout, Jr., is a typical example of amateur progress. This station has established two-way communication with twenty-one foreign countries since the beginning of 1926 and the log of the station reveals conversations with South Africa, Australia, Spain, the Argentine, Alaska, Malta, England, Norway, Italy and other countries thousands of miles away. It was 2NZ that talked with station KEGK, the *S. S. Chantier*, base ship of the Byrd Polar Expedition, for seventeen days, handling press and private messages. Most of the communication was done on 38 meters at night and up to the time the *Chantier* was 3,000 miles away from New York, good daylight transmission was obtained on 20 meters. South Africa also copied the signals from 2NZ on 20 meters during daylight hours.

Operator Strout explained that all results were obtained by using one UV-203-A 50-watt vacuum

AN AMATEUR TRANSMITTER

Wood is used for the panels of this 250-watt set. It is contended that maple is superior to composition panels for short-wave transmitter construction

ANOTHER AMATEUR'S SET

This photograph shows some of the apparatus at station 2EV, owned by J. D. Kilpatrick. Signals from here have been heard by other amateurs in many different countries

tube with an input of from 100 to 350 watts. The transmitting circuit is a tuned grid, tuned plate arrangement, which was found best of the self-excited circuits because of its steadiness on short waves. Proper tuning and a good filter for the plate supply give the transmitter a note practically the same as that of a crystal-controlled circuit.

A complete description of the transmitter and receiver used at 2NZ, together with the circuit of each, will be found in the Radio Notes section of this issue.

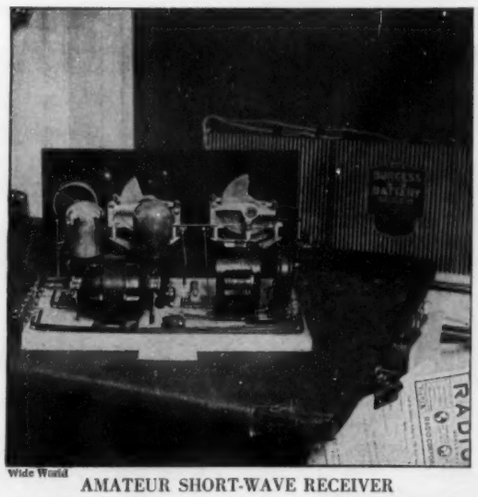
The antenna of 2NZ is a flat-top, inverted "L" type, forty feet high and ninety-five feet long over all. The antenna proper is forty-eight feet and the remainder forms the lead-in. The counterpoise, built directly under the antenna, consists of three wires each ninety-five feet long and spread out in a fan shape, separated thirty feet at the far end.

Amateurs Have Aided Research

Aside from the amateurs signaling around the globe, they have contributed much to the reservoir of radio knowledge by learning the secrets and observing the vagaries of the ether. They have found out that short waves skip and jump around the earth and that the skip-effect is much more pronounced at night than in the daytime. For example, stations in New York are heard clearly in Australia without anyone in the United States being able to tune in the signals outside of an eight or ten-mile radius around the transmitter, the area of which is penetrated by a rapidly absorbed ground wave. The short waves are projected high into the upper atmosphere, probably about 100 miles above the surface of the earth, to be reflected back to the ground thousands of miles distant from their source.

Operators in the vicinity of Washington, D. C., report that it is a common experience, when working in the forty-meter band, to notice that, as the ionized layer of the earth's atmosphere rises to high altitudes after sunset, the skip distance is increased so that the New England short-wave stations become gradually weaker as the night hours gain in darkness. At the same time, European stations working in this band and the mid-west and west-coast stations, as well as stations in New Zealand and Australia, are heard very loud. This effect is said to be caused by the sky-wave which passes through a medium not capable of absorbing the radio energy and therefore the waves actuated by a small amount of power travel over such long distances.

Another interesting observation that has been made in the short-wave field is that it is entirely possible



Wide World

AMATEUR SHORT-WAVE RECEIVER

E. S. Strout, Jr., of New York, contends that he was the first amateur to establish communication with the Byrd Polar Expedition. This is the receiving set that was used in performing the remarkable feat

to receive signals over a greater distance than one-half way around the earth. Knowing the properties of these waves, engineers have definitely stated that if Johannesburg, South Africa, hears a Pacific coast station at a time of day when there is nine hours of daylight between the transmitter and the African receiver, that a forty-meter wave could not possibly have traveled such a distance during daylight; therefore, it must have gone the other way around the globe, which would be 16,000 miles.

The development of the short waves for long-distance transmission has enlarged another of the amateur's fields. This is the one in which he "handles traffic." At any time, an amateur is only too glad to transmit a message gratis for anyone, upon request. By so using his apparatus under service conditions, he has a chance to make tests that will show him the value of his experimental work.

The amateur's method of sending a message, from New York City to Mexico City, for instance, is to listen in on his short-wave receiver and try to pick up the signals of some other amateur in or near Mexico City. Failing in this, he sends out the signal CQ, meaning that he wants to establish communication with someone and follows this with his own call-letters. In some cases he will insert the name of the city for which his message is destined. If luck favors him, he will establish contact with a station that is at least within local telephone call distance of the party to whom the message is addressed. The receiving operator will then forward the message.

Should it be found impossible to get in communication with a station close to the town of destination, the operator will send the message to some other station from whence it will be relayed on its way.

Today, with the record distances that can be covered with short waves, relays often include only three or four stations. In the days only four or five years ago, a coast-to-coast relay in the United States often required the services of a dozen or more transmitters. This, of course, was because of the relative inefficiency of the transmitters in use and also because the longer waves were not as good for long-distance work as the short waves. A few years ago, it was necessary to use one-half to one kilowatt of energy to transmit over a distance that today can be covered with one one-five-hundredth of that power.

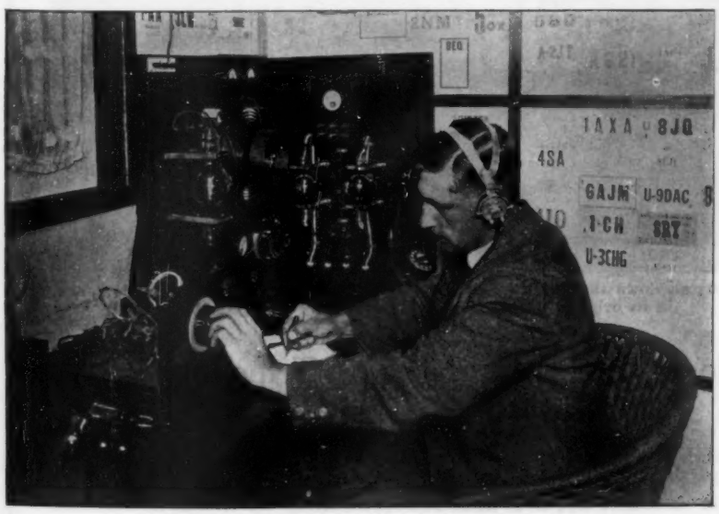
Type of Aerial Depends on Location

Amateur experimenters have found that in short-wave transmission, placing of the aerial and run of the lead-in is important. The free end of the wire, that is, the end opposite that where the lead-in is attached, should be higher, if both ends cannot be of the same height. The aerial should be above surrounding buildings and trees and there must be no sharp bends in the lead-in. The counterpoise should be about eight feet above the ground.

The advent of short waves increased the popularity of number 12 enameled copper wire instead of number 14 hard-drawn copper wire which was used for amateur aerials for many years. The high-frequency currents travel mostly on the surface of the wire, and if oxide collects on the surface of the aerial, the resistance is increased and the efficiency of the system is reduced. The enamel coating prevents air from acting on the copper and causing corrosion.

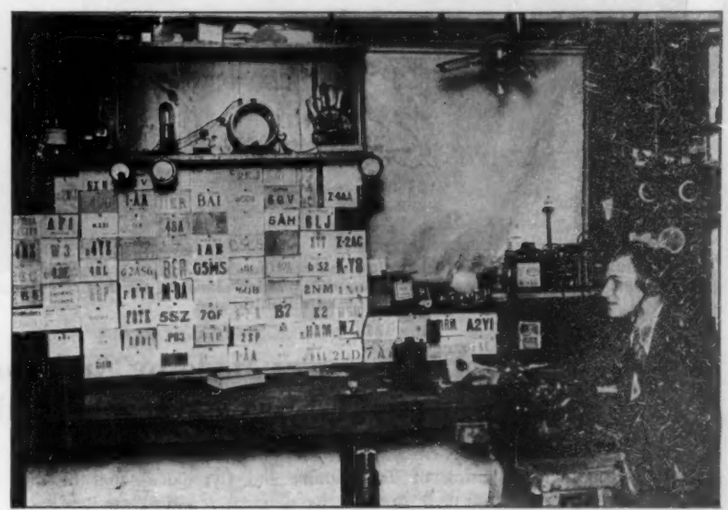
The question as to whether a flat-top or cage aerial is most efficient can only be decided for each particular location by experiment. Because operating conditions differ, the cage type is preferable where space is limited and amateurs have found that a cage about six inches in diameter is a satisfactory size. The lead-in should be a small cage in order to minimize resistance.

It is best to use a minimum number of insulators in both aerial and counterpoise and for short-wave transmission and reception long thin insulators are superior to the short type. It is more efficient to put one insulator at each end of the aerial and counterpoise rather than at the end of each wire.



PUTTING AUSTRALIA ON THE RADIO MAP

This short-wave transmitter at 3EF, Melbourne, Australia, enables its owner, H. W. Maddick, to communicate around the world. The set has been heard in every state in the United States as well as in Sweden, Italy, China, Canada, Mexico and other countries



Herbert Photos

PRIZE TROPHIES OF AN AMATEUR

Cards reporting reception of the signals of station 2APV, New York, show that the transmitter has been heard in every part of the world. The large letters on the cards on the wall are the calls of stations that have heard the New Yorker and have reported

Illustrations through the courtesy of the "Illustrated London News"

A typical Phoenician tomb sunk in the desert region of Bu Kemmash, the ancient Pisindon, in Tripolitania. An ornamental cone, which has disappeared, once topped the pedestal

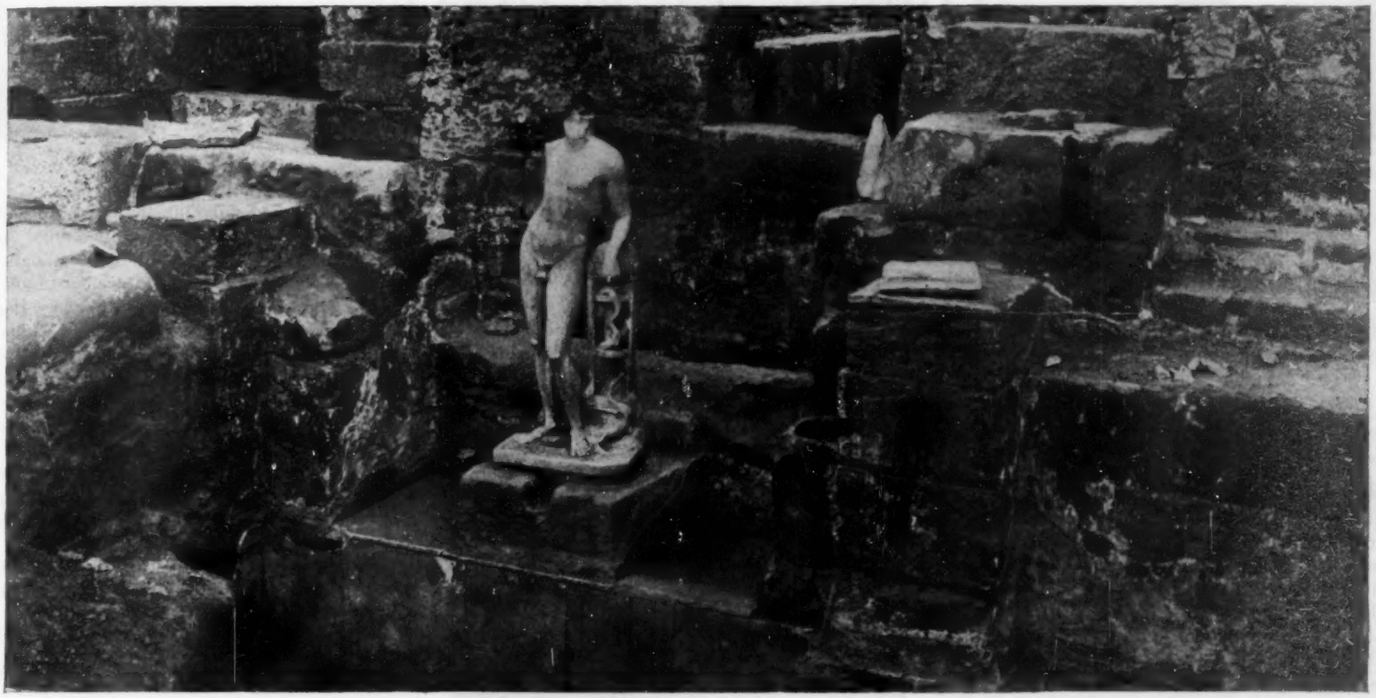
A christian tomb constructed of gypsum and masonry, found near Tripoli, at Ain Zara (the ancient Abrotnon). It bears an inscription in Latin the Roman letters of which are practically as clear and legible today as ever

The site of a former Phoenician city, Sabrata (modern Zuagha), on the coast of Tripolitania. The massive ruins which show on the left are those of the later Roman amphitheatre

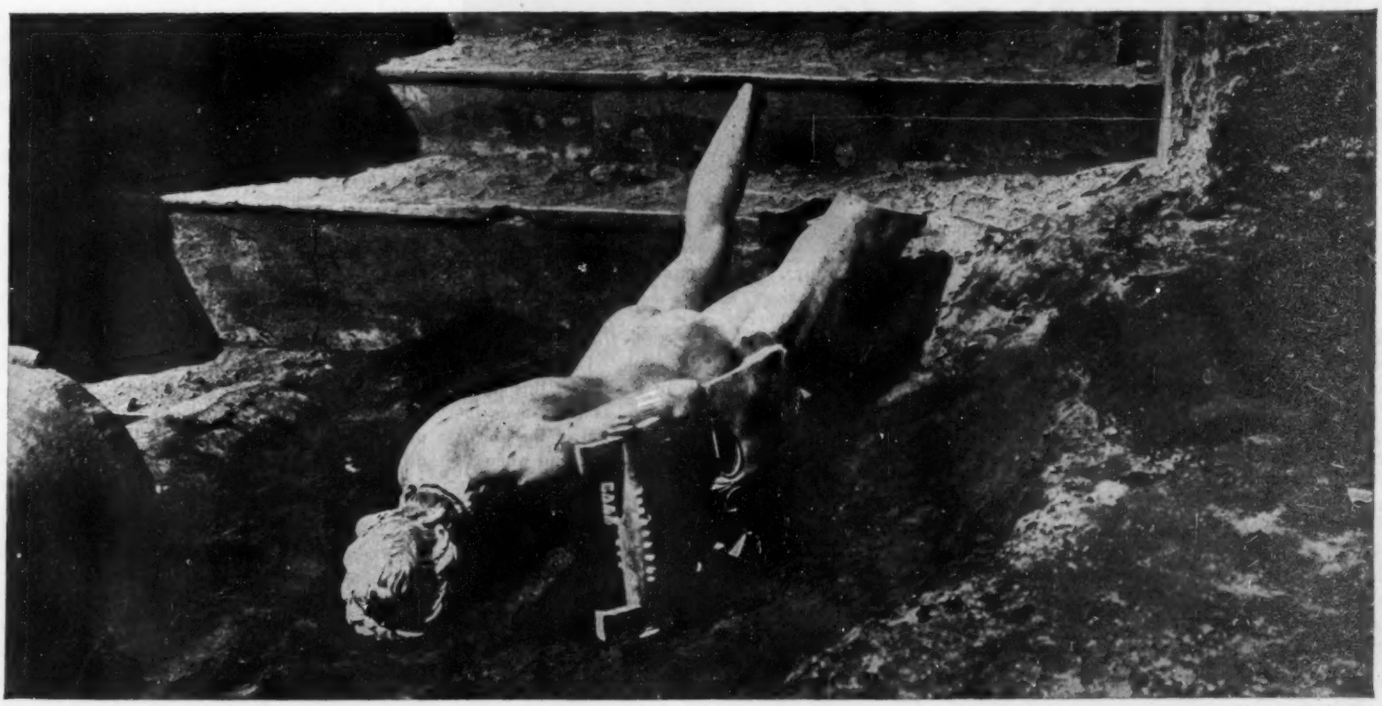
Standing all down through the centuries—a headless statue of Aesculapius, found in its original position in the Roman baths of Leptis Magna

Important Discoveries Made by Archaeologists at Leptis Magna, in Tripolitania, the Italian Possession on the South Shore of the Mediterranean Sea

"The Italian Government is carrying out very brilliantly the task it has set itself since the occupation of Tripolitania and Cyrenaica—that of the thorough exploration of their great archaeological remains," writes Professor Federico Halbhaar, of Rome, the well-known archaeologist, in the *Illustrated London News*. "Few countries of the ancient world can boast such a wealth of monuments of the past as these two African provinces. Four civilizations, from the prehistoric ages down to the Turkish Conquest in 1550, have left, in as many superposed strata, the records of their rise, acme, and fall: the early Libyan, the Greek and the Roman, in Cyrenaica; the Libyan again, the Phoenician and the Roman, in Tripolitania; and



A remarkably beautiful marble statue of Apollo, as the Pythian god of prophecy, found in the great Roman thermae, or baths, at Leptis Magna (modern Lebda), in Tripolitania. Unfortunately the statue is headless, and the head was not found during the excavation. The Greek and, later, Roman god Apollo, among his other attributes, was supposed to be all-seeing, and hence was the master of prophecy. He had many local titles



Lying prone as it was actually found in the thermae of Leptis Magna—Apollo as the god of music, or Apollo Citharoedus, the lyre-player. He holds a lyre in his left hand. Fortunately the head has not been lost, even in the fall which the statue must have suffered

over these, as the last, but not the least important, the Arabic in both those regions. The most recent discoveries have been made in Tripolitania. Since 1920, chiefly after the appointment of his Excellency Count Volpi as Governor of that province, very important and extensive excavations have been executed on many ancient sites of that territory, the most fruitful of which are those of Lebda—Leptis Magna—where splendid monuments of the Roman domination were lately brought to light. Leptis Magna, so called by the Romans to distinguish it from a minor Semitic settlement of the same name—Leptis Parva—near the Carthaginian frontier, was the leading city of the ancient Tripolitis, the other two being Oea, the present Tripoli, and Sabrata, now Zuagha. Founded by the Sidonians on the coast between the promontories of Ras El-Msel and Ras Serik, about seventy miles east of Tripoli, where the mouth of the Wady Lebda allowed the construction of a safe interior harbor, Leptis Magna grew, in progress of time, to such importance and extent as to occupy a space about four miles in circuit. Its great beauty, the fertility of its surroundings, and the wealth of its inhabitants, excited the admiration of the ancients. It was also a great emporium for trade. The city was almost entirely rebuilt after the Roman Conquest, and especially in imperial times by Septimius Severus, who was a native of Leptis."

Hunting Fossil Insects

Even a Modest Expedition, When Properly Conducted, Can Bring Forth Much Knowledge of Scientific Value

By T. D. A. Cockerell

Naturalist, and Professor of Zoology at the University of Colorado

I WISH I could find a fossil dinosaur, fifty feet long, to astonish the world. But that is a foolish wish, when I stop to think about it. I could not possibly afford to have it dug out, shipped and prepared for exhibition; and if I could, where could I keep it? Dinosaurs, and mammoths, and the like, are not for ordinary folks with limited resources. So it is just as well to remember that size is not the important thing in science. In recent years, it has been from the study of little things rather than big ones that advances have been made, and new fields have been opened.

The study of fossil insects has several advantages over that of dinosaurs. Very little apparatus is required; a pick and shovel, and a butcher knife will do very well. The knife is used for splitting shale, by hitting the edges of the pieces. The moral qualities necessary do not differ from those in other scientific pursuits; patience, perseverance, willingness to put up with some physical discomfort, and a capacity for being thankful for small mercies. The scientific results may be important. It is laborious, difficult and costly to obtain a single dinosaur or other great beast, which may or may not be new to science. When collecting fossil insects, we usually obtain many kinds, including new genera and species. A single day's collecting will often produce several forms entirely new to science, and frequently we find a specimen which carries the history of some insect group back several million years. A johnny-bag, instead of a two-ton truck or a line of camels, will be the means of conveying the precious materials to our base.

Fossil insects are not found everywhere, and it may seem to some a disadvantage that they often turn up in remote places. Actually, we esteem it an advantage, because it takes us off the beaten path, and affords an excuse for adventure. It is easier to travel now than formerly, and while expeditions on the most modest scale cost money, they are possible for many who are in no sense wealthy. People ask me why I do not have an automobile. I reply that instead of spending time and money that way during the winter, I can go abroad in the summer, and really accomplish something. Thus it has happened that my wife and I have not only worked at Florissant and in the Roan Mountains of Colorado, at Oeningen in Baden and Gurnet Bay in the Isle of Wight, but also in Siberia and the mountains of northern Argentina. Just now, we talk about the possibility of visiting Turkestan.

The Quest Leads to Siberia

Several years ago a Russian geologist named Kusnetzoff was investigating the Amagu region of Siberia, on the coast opposite the southern end of Sachalin Island. On the bank of the small Kudia River he picked up a couple of fossil insects, which were eventually sent to the United States National Museum, and transmitted thence to me for study and description. They proved to belong to the Tertiary epoch, and as nothing had been known concerning the Tertiary insects of this region, they were extremely interesting. We decided to go to the locality, though we had been told that it would be impossible. Through Dr. Kryshtofovich of Vladivostok we obtained permission to enter the country, in spite of the fact that no official visa was possible from our government or the Japanese.

As soon as the spring term of 1923 was over, we hastened to San Francisco to take the *Taiyo Maru* for Japan. The California Academy of Sciences gave a dinner in honor of our expedition, and many interesting speeches were made by distinguished naturalists.

The voyage across the Pacific was delightful, including a wonderful day at Honolulu, where we met all the resident entomologists and were most hospitably entertained by them. On June 22 we reached Yokohama, and taking the night train, crossed Japan

Photograph by the author

A SCIENTIST'S HOME IN THE FIELD

Professor Cockerell's camp on the Kudia River, Siberia

to the port of Tsuruga, where the *Hozan Maru* stood ready to take us to Vladivostok. Unforeseen circumstances caused a delay of a week at this point, but we were glad to have it so, as it gave us the opportunity to see the real Japan, out of the tourist routes. The Japanese were very kind, and when we finally left for Siberia after a week among them, we were seen off by a delegation bearing presents.

It was not without some apprehension that we approached the Siberian shore, not knowing how we should be received. But when the Soviet official came on board, he passed our papers with great politeness, and there was Kryshtofovich awaiting us at the wharf. Established at Vladivostok for a time, we had many interesting experiences. The governor of the Province received us in a very friendly manner, making a speech in Russian which was translated to us by an interpreter. He also gave us his mandate, requiring every one to treat us well, a document which smoothed our way on various occasions.

The scientific men of Vladivostok arranged a banquet in our honor, and many kind speeches were made. We were shown the various scientific and educational establishments, including the excellent Natural History Museum. Through the kindness of Dr. Kryshtofovich, we were able to secure the services of a guide and interpreter, Mr. A. I. Lavrushin, whose services were invaluable.

We were still far from the fossil bed, which is some four hundred miles up the coast from Vladivostok. There is no road, and the only way to reach the locality is by sea. We accordingly took passage on the small coasting steamer *Aleut*, and after a few days found ourselves at the village of Amagu. The people here are Russians, belonging to an ancient sect commonly known as "Old Believers." They are isolated from the rest of the world—literally and absolutely so, during the long winter months—and carry on their affairs much as they have done for many years past. Yet they have a good farming country, and do not lack the necessities of life. The government expects to establish schools, and already it was easy to see the influence of the long arm of the republic. The head man was posting up government propaganda texts on his gate; one of them read: "Without cooperation, not even a plow; with cooperation, a TRACTOR."

Far Afield in a Tent

My wife wrote her impressions in a letter at the time, as follows: "At last all our cargo was landed, and a very primitive cart, the only sort known in this village, was brought, and the baggage put on board, while we trudged behind through deep mud to the village about a mile away. We had "tenant" with the head man of the village, a big handsome man with a long reddish beard, really very grandly dressed in a pink blouse. The house was a typical peasant house, with the big stove built in the side of the living room and a six by eight oven in the kitchen, with a smaller stove beside it for boiling, et cetera. A shrine in the corner of each room held the sacred images, and guests upon entering the house made the holy signs even before greeting the people in the house.

"The building opened upon a large court or corral where pigs, chickens, geese, cats, dogs, cattle and horses wander around, making much dirt and constant noise. The two-roomed house seemed small for its dozen or more inhabitants, but the people were most hospitable, and our guide thought it not practical to put up our tent. The house was very dirty, and we feared the food would be quite impossible, but even the poorest Russians seem to understand the preparation of food, and our supper of cottage cheese covered with sour cream, wild strawberries preserved in honey with plenty of bread and butter and fried salmon was certainly a surprise. At another meal we had batter boiled in milk, with butter, and I was allowed to make coffee. Their religion allows them to drink whiskey, but not to drink tea or coffee, although at our last breakfast our host surprised us by drinking coffee with us. Our guide explained that even the Old Believers have had their revolution."

Our things were again loaded on a wagon, and our good host, Mr. Shareipoff, brought them to a flowery meadow. Here we decided to pitch our tent, by the cool waters of the Kudia River, in the shade of sweet smelling poplar trees, with splendid lilacs in bloom a few yards away. This was inland from Amagu, but it was still possible to see the ocean from the crest of a nearby hill. Larch trees (believed to be the lately described *Larix olgensis* of A. Henry) were numerous, and species of maple (especially *Acer pictum* of Thunberg) grew near the tent. The only oak was the low-growing *Quercus*

mongolica of Fischer. The lime-tree or basswood, *Tilia amurensis*, was found in flower. Conspicuous among the herbaceous plants were splendid orange globe flowers, bright scarlet Lychnis, and many other beautiful things, making the place a botanical paradise. We heard the voice of the cuckoo, just as in England. Many new species of bees were caught, and the butterflies were numerous and splendid.

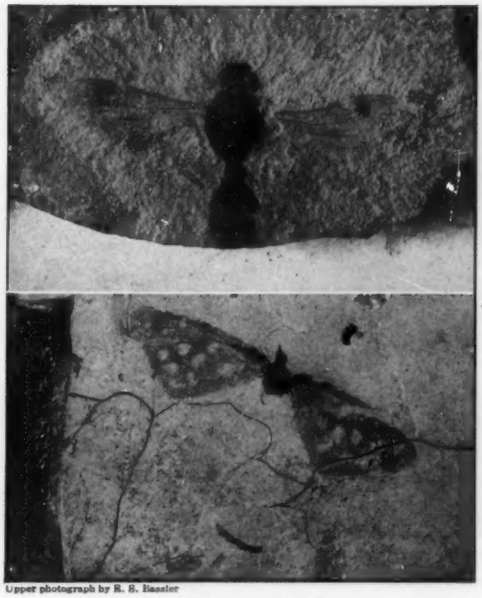
The fossil bed was not far from our tent. Unfortunately the soil above had fallen down, forming a talus slope which moved at the least disturbance. It was therefore difficult to get at the deposit, and when we did get at it, it was rather disappointing. Sometimes hours of digging would produce little of value, except fossil plants, which were numerous and varied. Nevertheless, when all our materials were gathered together, I had twenty-one new species of fossil insects to describe, some of them very beautifully spotted or banded.

Fossil Fish in Argentina

We considered the expedition quite successful, for although the fossils might not in themselves justify the trouble and expense, they had led us to a wonderful country, and caused us to have experiences not easily forgotten. Moreover, the discoveries among living insects and snails were many. On the way home, we came very near losing everything, and indeed our own lives, in the earthquake at Yokohama; but we reached security by a narrow margin, and eventually arrived in Colorado with the collections intact.

It is a far cry from the coast of Siberia to the mountains of northern Argentina, but Mr. G. L. Harrington, a geologist of the Standard Oil Company of Bolivia, had discovered a deposit of fossil insects in the Santa Barbara district of the Province of Jujuy, not far from the Bolivian border. Here again the fossils came to us through the United States National Museum. This was the first deposit of the kind to be found in the whole of South America, so there was nothing to do but go and investigate. We sailed on June 13, 1925, from New York for Buenos Aires, which we reached on July 4, after a very pleasant voyage in the good ship *Vestris*. Mr. Harrington was away in Bolivia, but Mrs. Harrington very kindly invited us to her home at Haedo, a suburb of Buenos Aires, where we spent a week getting ready for the expedition.

We were very fortunate in having Mr. Eugene Stebinger of the Standard Oil as a fellow passenger on the train northward, and getting from him much valuable advice, as well as the loan of a small waterproof tent. Eventually we found ourselves at San Pedro de Jujuy, on the Leach Brothers estate, where



Upper photograph by R. S. Bassler

TWO FOSSIL INSECTS

UPPER: *Earliest known fossil wasp, discovered in Colorado.* BELOW: *A fossil butterfly found by Mrs. Cockerell*

we enjoyed the hospitality of Mr. and Mrs. R. C. Anderson. This is a great sugar-cane country, and the way in which the industry has been developed by the five Leach brothers from England, in a period of about forty-five years, commands our admiration and respect. It would be hard to find a better example of the results of ability and industry, combined with moderation in living and kindness to the people employed.

We were still a long way from the fossil bed, and should have found it difficult to get there but for the kindness of Mr. Anderson, who had us taken in an automobile as far as the road went, and provided mules and a guide to take us along the trail. The car stopped in the midst of a beautiful forest, where Daniel Rios and his brother awaited us with the animals. Now began a journey up and down the steep hills, through fine country, but tiring to people who had not ridden for a long time. It was quite late when we reached Sunchal, which proved to consist of a single poor ranch.

Although we were nearly on the tropic, it was cold and misty, with condensed moisture dripping from the trees. We pitched our little tent, and cooked on an open fire outside. The next day we proceeded up the gulch, and soon found Mr. Harrington's locality. The fossils are in a peculiar green rock, which readily breaks into small blocks. There was no trouble in finding specimens, but nearly all were beetle wing-covers, which are not very satisfactory for classification or stratigraphy. Nevertheless, we got a fine little fish, representing a family of armored cat-fishes not before found fossil; part of a male cricket, showing that in former times these animals sang as they do now; the forceps of an earwing; species of Hemiptera, and other things of interest. Some of the beetle elytra are elegantly marked with striking patterns.

The life of this region is of a semitropical type, with immense trees but no palms (except in the dry lowlands), many green parrots *(Amazona aestiva)* but so far as we could see, no monkeys. Great snails, common under the trees, proved to belong to a little-known species not represented in North American collections. I was able later to publish the first good figures of this shell. A small butterfly, picked up in a chilled condition, turned out to be a Brazilian species new to Argentina, and the same was true of a conspicuous scale-insect. The common shrubby groundsel growing by our tent was called *Senecio brasiliensis*.

The Human Side of Science

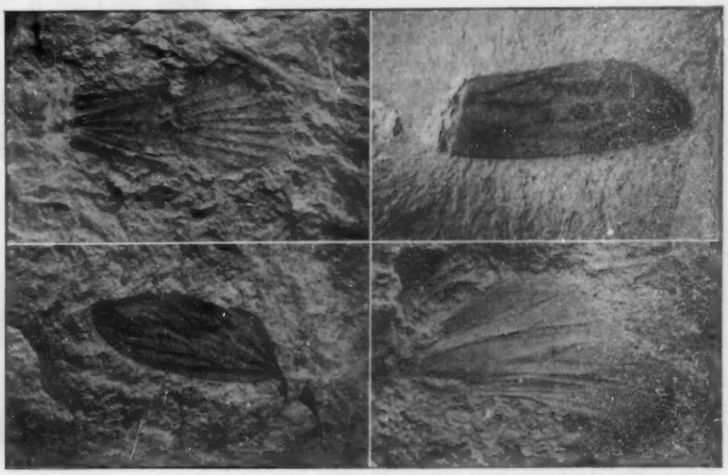
I have given only a very brief sketch of the Siberian and Argentine expeditions, but enough perhaps to show what we met with, and how it was possible to attain success. Nothing stands out more clearly than the kindness of the people with whom we had to deal, and among the various gains, we count most precious the friendship of those who aided us. Science, from its very nature, is international, and perhaps those who wish to promote international friendship cannot do better than facilitate scientific intercourse between nations. This is most effective when carried on privately, among individuals, rather than through formalities and ceremonial. Not only will scientific workers aid one another, but non-scientific people gladly lend their aid, without expectation of recompense.

From the standpoint of the individuals participating in an expedition, whether in search of fossil insects or the Holy Grail, there is the immense satisfaction of having an objective to be attained, combined with the certainty of interesting experiences by the way. There is no better means of education, always provided that the prerequisite courses have been taken. The prerequisite courses in this case are those, formal or informal, which have stimulated a love of man and nature, a reasonable understanding of human and scientific problems, and a desire to learn.

Photograph by R. S. Bassler

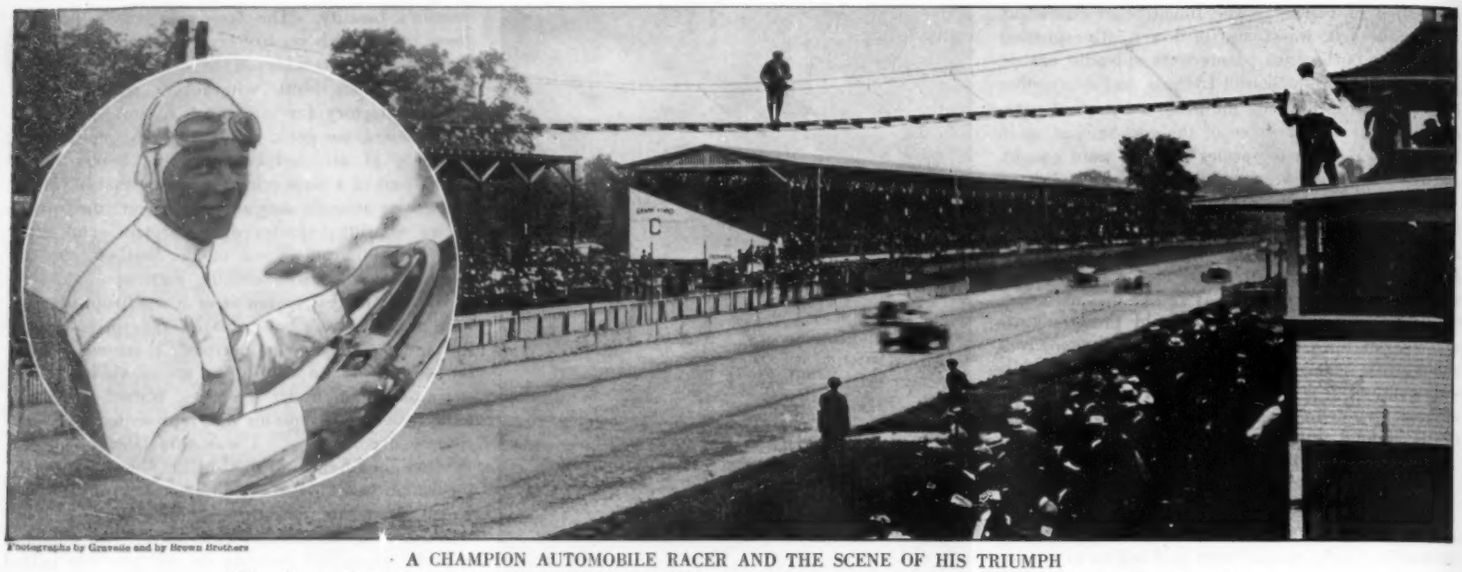
A GROUP OF FOSSIL BEETLES

These interesting fossils, enlarged about seven times so as to present details, were located at Sunchal, Argentina, by G. L. Harrington, a geologist of Bolivia



FOSSIL INSECT WINGS FROM SIBERIA

These are enlarged about 2½ times. UPPER LEFT: Limnephilus recultus. UPPER RIGHT: Megacercopis optima. LOWER LEFT: Plecia refracta. LOWER RIGHT: Philagra kudiana



Photographs by Gravelle and by Brown Brothers

A CHAMPION AUTOMOBILE RACER AND THE SCENE OF HIS TRIUMPH

The photograph in the insert shows Frank Lockhart, winner of the speed classic held this year on the Indianapolis race track

Guinea Pigs of Motordom!

How Automobile Racing Gives Us a Longer Ride for Our Money

By Nell Ray Clarke

NO one would think of the automobile race track as a practical laboratory, yet that is what it has become. It is in reality a proving-ground of ideas out of which the best are sorted for future use, possibly by the general motoring public.

It is a dangerous pastime, this furious clocking off of more than a mile and a half a minute. There are thousands of dangers—that of speed, of a collision, of skidding, of some broken part of the machine causing it to get beyond the control of the driver. Even a sparrow flying across the track has been known to injure seriously the eye of a driver. There is the danger from fire and from the bursting of a gasoline tank, which invariably burns the driver. Someone has called the drivers the *guinea pigs of motordom*, meaning that they are used in the automotive world just as are guinea pigs in research laboratories for trying out experiments.

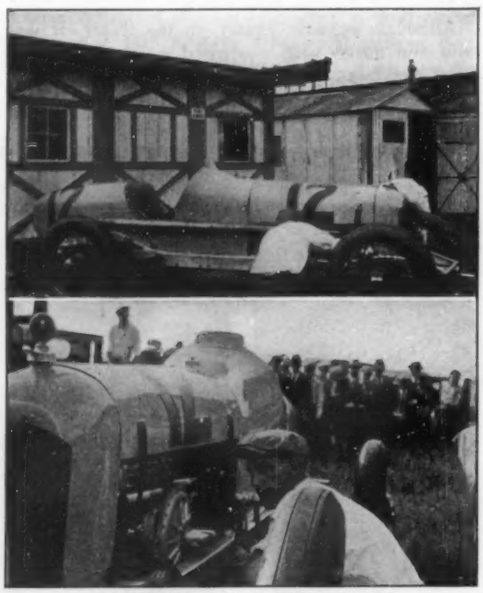
Motors Smaller Than Ever

Racing is a test of speed, but still more important each year is endurance—endurance of car and driver. It is a test of valves, valve springs, crankshafts, oiling systems, tires, ignition, spark plugs, gasoline and other mechanical and technical details. It is also a test of a man's capacity for standing physical punishment over a track that bumps him continuously for five or six hours, of his cool nerve, his courage, and of the response of his muscles to the will of his brain.

The cars are stripped for action. They are little and lithe, with canoe-like bodies. They are virtually motors on wheels. Their steel or aluminum bodies are somewhat longer than a man is tall, stream-lined to offer little or no resistance to the wind, and so narrow that the driver figuratively gets into his seat with the aid of a shoehorn. The dashboard in front of him is hardly wider than the rim of his steering wheel, and oftentimes a portion of this rim is cut out to enable him to squeeze into the seat.

Primarily the race is a test of the engineers, the men whose ideas are being tried out. It will tell each whether his years of research and labor have been worth while, or whether there have already been later developments which will render them useless. No one watches the races with keener interest than these engineers who helped design the motors, and usually they are to be found down in the pits with the "boys" where they can watch their inventions at close quarters. One may have contributed a spark plug, another a valve, another a cam, a piston-ring, or a supercharger, but they are all at the race, for some brain child of theirs is "strutting its stuff" before the automotive world.

In the first race on the Indianapolis Speedway in 1911, the motors had a displacement of 600 cubic inches or under. The race was won by Harroun driving a six-cylinder Marmon, with a piston displacement of 447.1 cubic inches—five times larger than the motor which finished first in the 1926 race—and the average speed was only 74.59 miles an hour. In those days, some of the pistons measured from 4½ to 7 inches high and were about the size of a quart cup. Today the pistons are about the size of milady's box of rouge.



ADDING THE FINISHING TOUCHES

Two views of Peter de Paola's eight-cylinder Duesenberg racer which was still being assembled when the other cars were qualifying for the race and which, although still stiff, finished in fifth place

The motors this year are about half as large as a Ford motor, 91½ cubic inches—smaller than motors have ever been in the history of racing. They are there with the horsepower however. The winner of the race, Frank Lockhart, a young Pacific coast Lochinvar, by driving his car at a speed of 115.48 miles an hour, established a new track record for a single lap. The former record of 114.28 miles an hour established last year by Peter de Paolo was made in a car with a motor one-third larger than those in the cars entered in the race this year.

Speed Steadily Increases

The average speed of 94.68 miles an hour maintained by the winner of the race this year is not as high as the average speed of the winner of last year's race—101.13 miles an hour. Attention should be called to the fact, however, that the motors were brand new and almost in an experimental stage, and it is believed by experts who watched their performance that they give promise of surpassing in speed and performance, when they have been perfected, the type used during the three preceding years.

"During the war," said one authority, (Fred Duesenburg), "the Government asked automotive engineers for a powerful engine, so we got together and pooled all our ideas. By selecting the best we could offer, we finally developed an engine of about 900 cubic inches which developed 203 horsepower. We thought we had done a pretty good job. Today, just eight years later we have produced a motor one-tenth that size which develops almost the same horsepower."

To encourage just this kind of efficiency, as well as to decrease speed and consequently the danger to human life attendant upon the race, track officials every two or three years have decreased the piston displacement of the motors to be entered. In spite

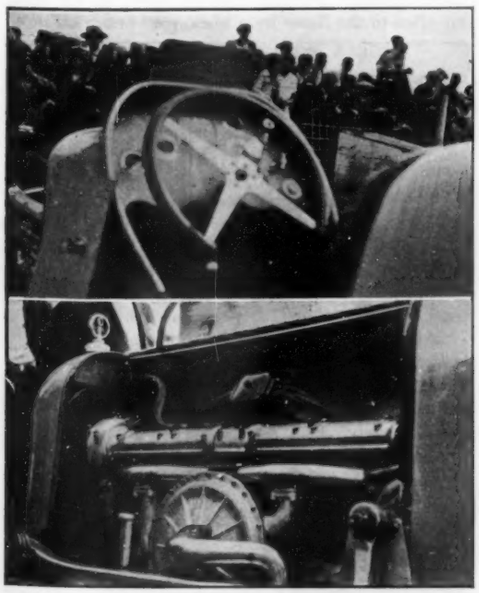
of that fact, however, the speed made on the track has steadily increased.

Another authority, Harry Miller, furnished these specifications for the details of his motors and the other entries vary little therefrom:

The engines have eight cylinders in a line, arranged in two blocks of four. The combustion chamber is semispherical. There are two valves to each cylinder, two overhead camshafts, and spur gear drives. The crankshaft is counterbalanced, and there are five main bearings. The bore is 2 3/16 inches, the stroke three inches, and the piston displacement is 90.2 cubic inches. The weight of the car complete is 1,400 pounds, the length is 149 inches, the wheel base 100 inches, and the tread 52 inches. It stands 37 inches above the ground at the radiator, the height at the seat is 20 inches and the body is 18 inches wide. The car carries 4½ gallons of water, five gallons of oil, and 25 gallons of gasoline.

In the main features, the racing machine is not radically different from the passenger car. The engine is of the same general type, it has the same type of transmission, the same rear axle and differential, and the gear ratio, which ordinarily is associated in the lay mind with the speed which a car can make, is not essentially different. In order to permit the gas to pass more quickly into the cylinders, the valves have a larger area in proportion to cylinder volume. Of course, it goes without saying that most of the parts have been made with greater care than is exercised for the stock jobs and that there is greater nicety in fitting the parts together. The supercharger "peps" up the speed about half again what it would be without that very recent addition and it pushes the engine speed up to between 6,000 and 7,000 revolutions per minute.

The wheel diameter is 30 inches. The treads of the balloon-type tires are smooth and very thin, and the rubber along the sides of the tires is so thin that you can easily see the cords through it. The air pressure used is 35 pounds. The chief improvement in the tires for racing cars during the years, has consisted in getting substances to harden the rubber so that it can stand the abrasion, to the sacrifice of other factors which are desirable in tires designed for long use. There was less tire trouble during this year's race than ever before. In the race the tires get much too hot to touch—"plenty hot," as one mechanic expressed it—and sometimes they become hot enough during the grind to devulcanize the rubber.



TWO RACING SPECIALTIES

TOP: *The steering wheel is cut away so as to allow room for the driver.* BELOW: *A Duesenberg motor equipped with a supercharger, shown in the center of the motor*

Photograph by Gravelle

A RACING CAR DESIGNER

This photograph shows Mr. Schmidt, designer of the Schmidt Specials, with one of his extremely powerful yet small bore racing-car motors

Regardless of their names, most of the cars entered in this year's race were the creations of Harry Miller, two of them being front-wheel drives. Some manufacturers made adaptations of the Miller motor by substituting valves or other devices of their own creation, and then rechristened the cars. The remaining cars in the race consisted of two Duesenburgs, one of which was the much discussed two-cycle job, a dolled-up front-drive Ford, and three Schmidt Specials, which were of French make using single sleeve valves in the motors.

Fred Duesenburg has pioneered for the American motor car in the straight-eight motor, the supercharger idea, and the hydraulic four-wheel brake. The straight-eight motor and the hydraulic four-wheel brake have come into ordinary use. It is said that the supercharger will follow.

450 Miles on a Gallon of Gasoline!

This year Mr. Duesenburg tried out the two-cycle engine. The idea is not a new one, for Bill Turner finished in a two-cycle Amplex in eighth place in 1911. The new two-cycle model is not yet considered practical, but this engine was acquitting itself with credit until a rear tire went soft and it skidded and hit the wall, putting it out of the race due to a bent rear axle.

The supercharger on the Duesenburg cars is a device resembling a great snail shell attached to the side of the motor, which sends the fuel flying into the motor to develop additional power for more rapid speeds. This is really a centrifugal pump rotating at six to seven times crankshaft speed, or up to 40,000 revolutions per minute! It pushes the gaseous mixture of fuel and air into the intake manifold under a pressure of about ten pounds per square inch above atmospheric pressure.

The front-wheel drive Millers, another innovation this year, are not entirely new, for Walter Christie drove a car with a motor geared to the front wheels before the days when auto racing fixed Indianapolis on the map. The advantage of the front-wheel drive is that it eliminates the danger of skidding. The back of the car simply trails after the front wheels. It also enables the designer to reduce the frontal area which is exposed to wind resistance by seating the driver much lower in the car, as well as to lower the center of gravity. In the average car the back wheels push the front of the car about—a sort of cart-before-the-horse arrangement.

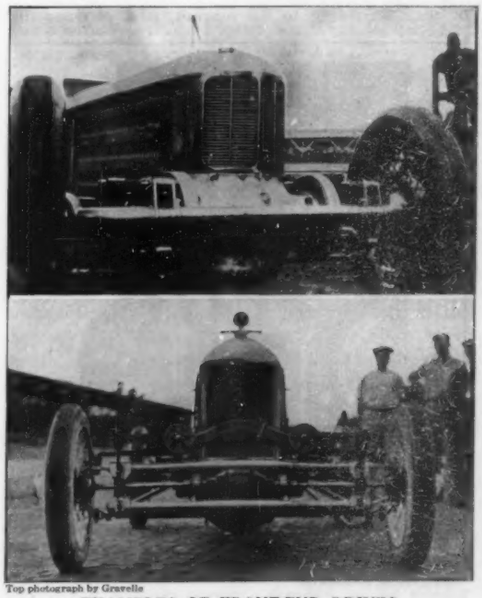
In the recent Indianapolis event the front-wheel-drive cars, although they did not finish the race, could take the curves at the same rate of speed that they could make on the straightaway, whereas the rear-wheel drives had to slow down.

It is evident that the general tendency through the years in motor development for racing cars has been toward an engine of small piston displacement, developing higher and higher power. What has been learned in racing has been applied to the passenger car and each year or two the motors in our passenger cars have grown smaller and smaller, but our speed has increased. In ordinary parlance, that means a longer ride for our money, or more miles to the gallon. Mr. C. F. Kettering, perhaps the foremost automotive engineer in America, has said that there is enough power in a gallon of gasoline, if it were used efficiently, to drive a Ford from Dayton to Detroit, a distance of 450 miles. There is yet something for these engineers to work for. Real fuel economy is the desire of all automobile drivers.

Those in the know believe that the engines in our passenger cars are going to grow smaller in the future and that in a few years we will be getting 50 miles to the gallon readily, without any sacrifice of speed. They point to the number of small cars now in use in Europe which boast that mileage. So highly are the engineering features of some of these motors being developed, that one automobile engine, manufactured in Italy, is now said to be able to make from 7,000 to 8,000 revolutions a minute.

At least it is safe to predict that whatever economies of construction or factors of safety are found practicable in racing cars will ultimately come to the joy-riding public. The man whose motor failed him on the race track has perhaps contributed more to you and to me than the man who won the race. Through these very failures, automotive engineers are learning the weaknesses and the flaws in their creations. That knowledge is power in their hands to better their output in the future and to aid the pleasure car driver.

Defects in our spoken language have caused the United States Navy to develop a system of communication that is not easily misunderstood. It will be described in our November issue.



Top photograph by Gravelle

EXAMPLES OF FRONT-END DRIVES

The photograph at the top shows a Miller Special that held the lead for 100 miles. At the bottom is a rebuilt Ford with the motor geared to the front wheels

Clean Comfort in the Home

How the Coal-burning Furnace May Be Converted to An Oil-burning Type, and the Results of the Change

By Louis S. Treadwell

THE difficulties of the owner of a coal-burning furnace are many. It is not only necessary to purchase a large quantity of fuel, usually at a time when the household finances are rather low, but it is also necessary to periodically transport this fuel from the storage bin to the furnace, by hand, and to otherwise take care of the heater. The shaking down and removal of ashes is a dusty job and one that the average house owner would be only too glad to get away from. These, and other objections to the use of coal as a house-heating fuel have led many to find a way out of the difficulty.

At the present day, house heating by means of oil seems to be the solution to the problem. Oil holds many advantages. It is easy to obtain and to store and a well designed and properly constructed oil burner will operate throughout an entire cold season without any attention whatsoever on the part of the owner.

How to Select an Oil Burner

When the house owner is considering the installation of some new type of heater in his present coal-burning furnace, there are two questions that are uppermost in his mind. The first is, "How does the cost of oil compare with coal?" The second question is "What is the best oil-heating device to install?"

A consideration of the cost of oil burners and of their installations as well as of the accessories necessary, brings us to the conclusion that at the present time, there is but little saving in cash that can be effected. However, there are many advantages on the side of the oil burner that would tend to overcome even an increased cost.

A fair comparison of the cost of a good grade of fuel oil as against coal can be obtained if we consider that 100 to 125 gallons, efficiently burned, will provide the same amount of heat as one ton of a good grade of hard coal. At 10 cents per gallon or less, according to the market, it is obvious that there will be an actual saving of from 25 to 40 percent in favor of the oil. There is, however, the additional cost of the pilot light, plus that of the electric current for the automatic control and motor. For the pilot light, the cost of gas will average 75 cents to $1.25 per month, and for electricity, $1.25 to $2.00 per month, making a total of from $2.00 to $3.25 per month. Moreover, heat will probably be used at least a month longer each year because of the automatic functioning of an oil system on chilly mornings and evenings, when building a coal fire would be too much trouble. It is this last consideration however, that makes an oil-heated furnace desirable, for it provides an even temperature in the house at all times, independent of human effort.

The cost of a good installation, including a storage tank of about 275 gallons capacity, runs from 350 to 550 dollars or even higher. Although there are cheaper devices advertised, it is usually found that either they are not as dependable, or that the cost of the extras which are not included in the advertised price for the mechanism, when totaled, will raise the complete cost practically up to these figures.

It is obviously impossible for us to advise each individual reader as to the type of oil-heating device that is to be installed. We have illustrated on these pages several types of oil burners that can be installed in standard coal-burning furnaces. Probably the best thing for a furnace owner to do in order to determine the type of oil heater that he should buy, is to communicate with the manufacturer of the coal-burning furnace that he has on hand. They will probably be able to tell him just what type of oil burner will be most satisfactory for use in connection with that heater. Another good plan is to get in touch with a company of heating engineers. They can act in the capacity of consultants and also as an intermediary between the consumer and oil-burner manufacturer. This latter course will not be any more expensive in the end because the company of heating engineers will get their commission from the manufacturer of the oil burner that you purchase. Furthermore, their experience with all types of coal-burning furnaces and with the installation of oil heaters therein will enable them to advise the consumer in the most intelligent manner possible.

In general, there are two types of oil burners on the market today. In one type, the oil is thoroughly atomized and mixed with air. This process is carried through by means of an electrically-driven pump. The other general type uses gravity feed. It is interesting to know that the United States Department of Agriculture has carried on numerous tests with these two types of furnaces and the results of these are expressed in the following paragraphs, quoted from a recent report of that department.

Good Combustion Essential

"The tests conducted show that the atomizing type of burner is higher in efficiency and has less tendency to soot than the gravity type. Fuel oil will not burn readily when a flame is applied to its surface and hence the oil must be prepared for combustion. In the gravity-feed type, some device such as a hot plate is necessary for volatilizing the oil. In some types, the plate is heated to get the fire started after which the heat of the oil burning on the plate is relied upon to keep it hot.

"Air is generally brought into the furnace by the natural draft produced by the chimney. Ingenious methods have been used to induce an intimate mingling of this air with the vaporized fuel. In general, good combustion is not secured by this means. While the principle seems simple enough, the fuel and air are not mixed with sufficient thoroughness to produce a good clean flame. In the cheapest burners of this class, the burner is started and controlled by hand.

"The atomizing type of burner includes the spray type and those which break up the oil by forcing it under pressure through a small opening, air being supplied to the flame by a blower or pump arranged

Solving the Heating Problem

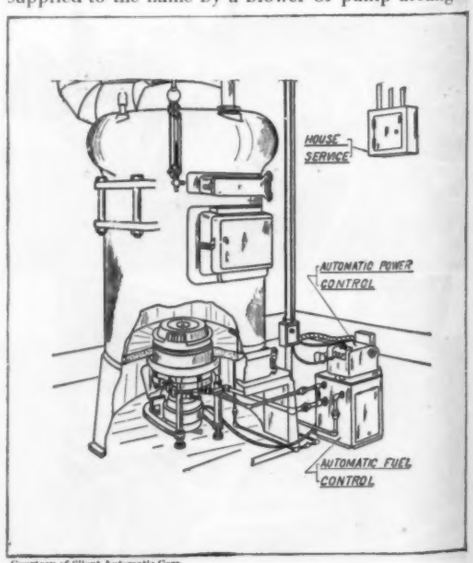
It is but human to want the greatest comfort in one's home, and so the problem of heating the home in an efficient and healthful manner is one that occupies a great deal of attention. The market has recently been flooded with numerous types of oil-burning devices that are designed to be used in standard coal-burning furnaces. The interest in these has been so great that we have made an extensive survey of the situation and this has led to the conclusions that are put forth in the accompanying article. In the selection of a home-heating plant of the oil-burning type, the average person should not feel competent to judge for himself as to the one to buy. This important detail should be left to some one who is constantly in touch with the oil-burner manufacturing field. If any reader who desires to install a new heating system will follow this article, we are quite sure that he will have little or no trouble with an oil-burning plant.

—The Editor.

Courtesy of Super Oil Heater Co.

SELF CONTAINED

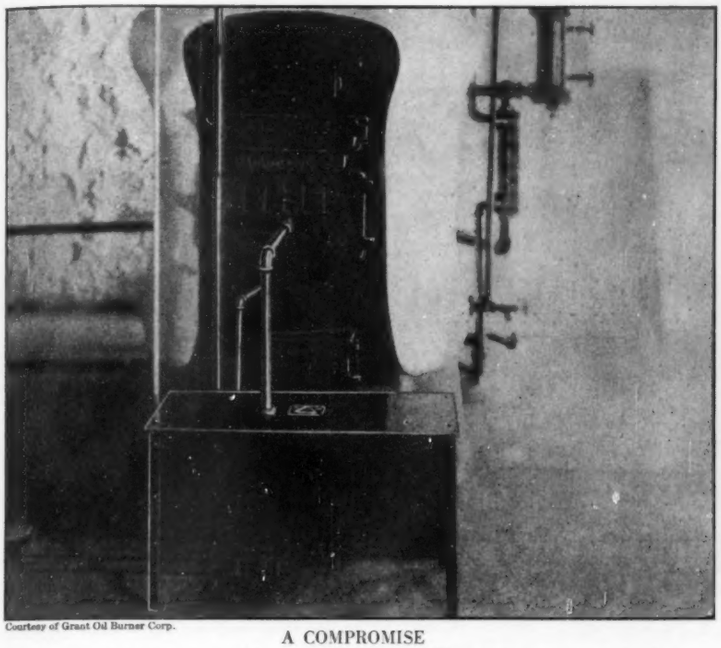
Here the mechanism is placed in the ash pit. Only the carburetor is outside the heater. The mechanism is supported by springs to deaden vibration and noise



Courtesy of Silent Automatic Corp.

AN EFFICIENT TYPE

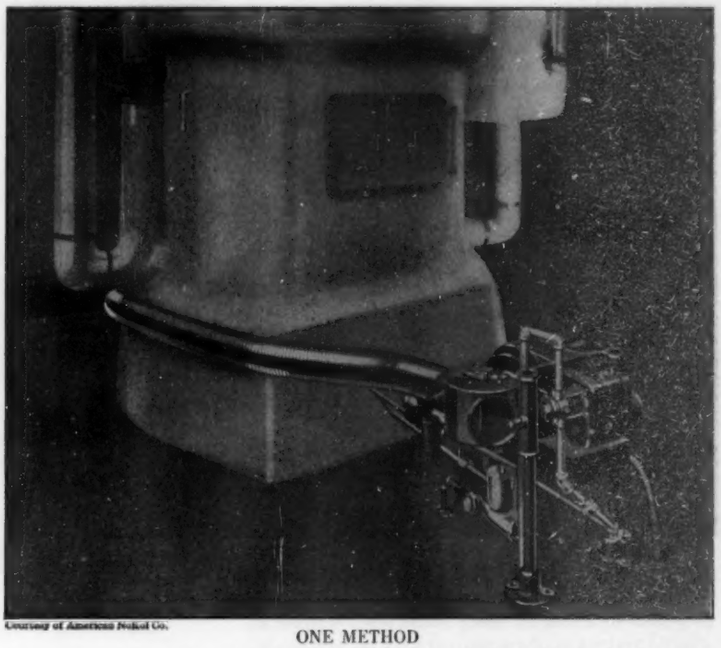
After it has been emulsified, oil is thrown from a spinning disk through peripheral breakers. Thus, a swirling motion is imparted to the mixed gases of combustion



Courtesy of Grant Oil Burner Corp.

A COMPROMISE

In this type of burner no special setting is required. The existing grate and fire box are lined with fire brick giving a refractory surface which adds volatilization of the oil



Courtesy of American Nokol Co.

ONE METHOD

A proportion of the stack gases is drawn into the blower and mixed with air, thereby retarding the liberation of the heat units and effecting greater dilation of the flame

so that it can be regulated. The spray type of burner consists principally of an air and oil nozzle arranged so that air from a motor-driven compressor blows directly over the oil nozzle, creating a partial vacuum. This draws from the oil supply a finely divided oil spray in somewhat the same manner as gas is supplied to the cylinders by the carburetor of an automobile. The rate of feed is controlled by the air pressure and nozzle opening. Automatic control with a thermostat is generally used.

"For the atomizing type, gas or electricity, or possibly both, are required for ignition, and electricity is used to operate the motor which drives the blower and oil-pump unit.

"Gravity-type burners are installed at a cost as low as 30 dollars, but in addition to the objection of sooting and inefficient combustion, they require a high-grade fuel costing more per gallon and containing fewer heat units per gallon than lower grade oils."

Cleanliness an Attractive Feature

After oil heating has been installed, the furnace man—be he owner or hired—is done away with and the idiosyncrasies due to individual methods of firing are eliminated. It is only necessary to start the oil heater in the fall, to set the automatic temperature regulator at the desired point and forget about the furnace for the rest of the season.

The fuel oil that is employed in connection with an oil burner is stored in a tank buried in the ground outside of the house. A filler pipe for this tank extends out to the curb. In order to get a good idea of the comparison between coal and oil-burning facilities, form the two mental pictures described in the following sentences. A truck-load of coal is driven up to the side of a house, the coal chute put in position and bag after bag of coal rattles down the chute. This nerve-racking noise continues for possibly half an hour. After the coal man drives away, small pieces of coal are found within a radius of five or ten feet around the window or other opening through which the coal was introduced. These must all be picked up in order to keep the yard looking neat. After the furnace has been in operation for some time, the ash pile grows steadily higher and higher. An ash man comes and takes it away. He charges for his labor. The dust that is necessarily stirred up during his work is most annoying as it will sift into the house and settle everywhere that it is not wanted.

The other picture is far simpler. An oil-tank truck draws up to the curb and places a delivery pipe in the tube that connects with the home oil-tank. In a few moments, a hundred or more gallons of oil have been delivered without noise, dirt or trouble and the tank drives away. This is the last that is seen of the fuel, either in its original form or in the form of a burned residue. There are no ashes to be removed.

In one of the types of burners that we illustrate, an emulsified mixture of air and oil is shot downward toward a surface of heated bricks that have been placed over the old grate and around the fire box. The reflected heat from these bricks reacts to produce more efficient combustion. With this type of burner, the bricks can be removed from the fire pit and the furnace used for coal burning in case this should be necessary, due to a temporary failure of the electrical supply to the burner mechanism.

Another type shown is that in which practically the entire mechanism is set up in the ash pit with the ordinary coal grates removed. Oil mixed with air is thrown from revolving or stationary peripheral orifices through breakers, becomes volatilized and is burned like a gas. The mechanical mixture of oil and air is sometimes agitated further and projected toward a hot iron surface or a glowing refractory substance which aids more complete combustion. A pilot light fires the oil and a thermostat responsive to the heat of the rooms controls the speed of the actuating motor.

A combination of the two types of burners described above is also illustrated. In this very efficient unit, the actuating mechanism is placed outside of the heater and a burner in the pit causes the combustion of the oil. This particular system does away with the necessity of having brick linings or specially constructed refractory baffles.

There is one other feature to be found in connection with oil heating that we must not fail to stress. It is one that will appeal to all as it enables the home owner to obtain more space for living or recreational purposes. When a coal-burning furnace is used, a large part of the cellar is taken up by the coal storage bins. The ash receptacles that are a necessary part of the furnace equipment also take up space. The very nature of the coal-burning furnace eliminates the value of the remainder of the cellar for anything else than for the storage of materials that are not damaged by dust and dirt.

All this is not the case when oil heating is used. Then the heater and its apparatus takes up only a very small part of the cellar. The remainder at once becomes available for other purposes and the average home owner, after installing oil heat, usually takes advantage of this at once. It is not infrequent to find that a billiard or card room has been built in the place that formerly was occupied by the coal bins. A very convenient laundry also can be located in the cellar. Play rooms for the children and other space-saving ideas will present themselves.

Even Temperature Promotes Health

It must not be thought that the construction of such rooms in a basement will be highly expensive. The contrary is true. Plaster board can be used and the walls can be papered or painted at a low cost. In many cases, the man of the family will take delight in the work entailed in building these rooms.

With coal-burning furnaces of any kind, regardless of whether they be of the hot air, hot water or steam type, the fumes from the burning coal are bound to get into the house and to cause a disagreeable settlement of dust. This is not only bad from an esthetic standpoint, but the effects of the fumes on health are deterimental. With oil heating, all of this is done away with. The house is always heated at an even temperature due to the thermostatic regulation possible and in this manner, health is again promoted. It has been said by those who have never investigated oil furnaces to any great extent, that oil burners are noisy in operation. This was true of some of the original types, but recent improvements have done away with this and other deficiencies, and the public, today, can purchase well-designed oil-burners that will operate with the greatest efficiency and with the least amount of trouble and attention.

¶ *Atomic physics provides the key to the hidden secrets of the atom. In its excited state, the atom does some remarkable "stunts." Some of these will be explained next month by a noted physicist.*

A MINE ROOF COLLAPSES

The excavation of successive underlying strata of coal frequently causes heavy settlements at the surface. This shows such a settlement, aided by a bursting water main

A SUBSTITUTE FOR THE MULE

The mule, working, eating, stabled, thousands of feet below ground in a mine was one of the curiosities of mining. Now a storage-battery locomotive hauls the coal

Uncle Sam, Spendthrift—V

Waste in the Mining, Marketing and Using of Coal, and the Remedy

By J. Bernard Walker

HAVE you ever seriously considered how largely, not merely the comforts but the bare necessities of your daily life are dependent upon coal? Do you live in a city? If so, note the following facts. Your daily life begins with the pressing of a button, in response to which, coal, in the form of electric light, answers your call. The southern grape-fruit with which you start your breakfast is on your table because ice and the locomotive, in order to get it to your table, have consumed an amount of coal equal to the weight of your grape-fruit. Coal, as power, carries you to your factory or office; if to the factory, your labor is aided by coal through a power-driven machine; if to the office, you are lifted to your floor by coal acting through an electrically-operated elevator. By the way, this vertical transportation service consumes, in New York City alone, 250,000 tons of coal per year.

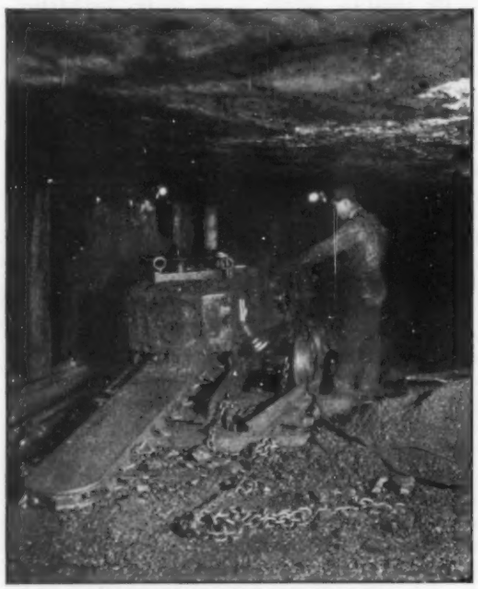
If you have the inclination and means to be up-to-date, your home is replete with many kinds of labor-saving, electrically-driven appliances, for the operation of which you are indebted to that silent but ever-present friend, "King Coal."

Fertilizer From Coal

So great is the contribution of coal to the daily life on the farm, as to justify the statement: "The story of wheat is the story of coal." To provide modern farm machinery involves the use of coal, in melting the iron out of the ore, in reducing the iron to steel, and in fashioning the steel into the harrow and the plough. We hear much in these days about nitrogen fertilizers, of which hundreds of thousands of tons are used every year on our farms. The nitrogen is a by-product of the coke oven, and one hundred and thirty tons of coal have to pass through the ovens to produce 100 tons of coke.

We are proud, and justly so, of the American harvester and threshing machine—coal has made them possible. The movement of the country's enormous crops to market could be accomplished in no other way than by our railroads, which are—and for many decades to come, at least in the wheat-growing districts of the west, will be run by coal. Coal drives the flour mill, and for every pound of bread, it is necessary for the baker to burn up one-third of a pound of coal.

The United States Coal Commission says that between 40,000 and 50,000 tons of coal invisibly reaches our table every day, but even that amount is small compared with the annual production from our mines of 500,000,000 tons of bituminous coal. Of this total, 28 percent goes to the railroads, 25 percent to the boiler houses of factories and mills, 15 percent to the coke ovens and gas plants, 10 percent to the homes of the people, 7 percent to the steel plants, 7 percent to the power houses and street railways, 4 percent is exported, 2 percent provides power at the coal mines, and the last 2 percent represents steamship fuel.



MACHINE REPLACES THE MAN

The coal-cutting machine now eases the labor of the miner

Truly, the dependence upon coal is not merely countrywide but is all-embracing. Hence, the questions of the reserves of coal in the ground, their ultimate exhaustion, the rate at which they are being mined and consumed and whether they are being mined and used wastefully, should be of the very deepest concern to every American citizen.

Skimming the Cream of the Coal Mines

The entire coal resources of the United States, exclusive of Alaska, have been estimated by the United States Geological Survey at the enormous total of 3,535,690,990,000 tons, which is nearly one-half of the total resources of the whole world. This estimate was made in 1913. The annual consumption of bituminous coal was 417,111,142 tons in 1910 and 579,385,820 tons in 1918. The total production in this country from the first opening of mines to the end of 1918 was about 13 billion tons. Comparing this with the estimated coal reserve of over 3,535 billion tons, it would look as though the last thing the United States has to worry about is the exhaustion of its coal supplies.

But, when we look into the details of the coal situation, we find that it is not so favorable as the naked figures suggest. In the first place, of the enormous total given above, only 21 billion tons represents anthracite and less than half of the total, or 1,441 billion tons is straight bituminous coal. The balance is made up of semi-bituminous, sub-bituminous and lignite. Furthermore, during the years in which the country has been mining coal, it has naturally mined the best coals and those which lie nearest to the manufacturing and industrial centers. As Dr. George Otis Smith, Director of the United States Geological Survey very pertinently has stated, "To the coal consumer on the Atlantic Coast, the average life of America's great coal reserves means much less in dollars and cents than the approaching exhaustion of the fields that lie nearest his boiler house. . . ." The tonnage remaining in the great

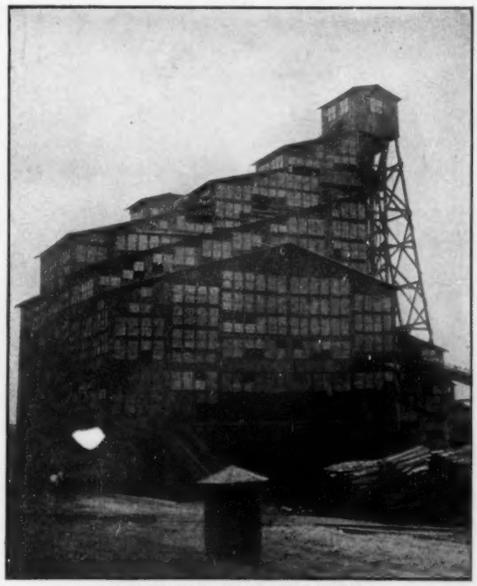
producing fields of the east is so limited as to make coal-saving a topic deserving the best thought of those concerned in power generation. Mr. Lesher, another authority, says, "The production of one billion tons of coal (as against the present production of say 500 million) in the United States in one year, is to be expected in the not very distant future."

As in the matter of our oil reserves, so in the case of coal—we have been skimming the cream by mining our best coals and leaving to posterity those which are of less value and will cost more to recover and transport. In 1881, the Pittsburgh bed in Pennsylvania was yielding 10 million tons a year and the life of that field was considered to be a matter of 30 generations. As a matter of fact, if that rich field continues to be mined at the present rate, the exhaustion of this, the largest coal bed in Pennsylvania, will take place within not 30 generations, but one. Again, the Georges Creek field—the main source of coal in Maryland—was yielding two million tons per year in 1880 and was estimated to have a life of 150 years. "To date," says Dr. Smith, "so far as the big vein is concerned, the field is regarded as almost worked out." The estimates of the life of the famed Pocahontas field have been reduced from four or five generations to two or three. The above are the fields which produce our choicest industrial coals, and although the outlook is better in the coal fields of Ohio, Indiana and Illinois, the coals are poorer and more remote.

Huge Loss of Coal Avoidable

Since we are using up the best of our coal at a rapidly increasing rate, the question of economical practice in mining below ground and in the use of coal above ground takes on very great importance. Are we wasteful with our coal? Is there a call for thrift in the mine and the factory? Most assuredly there is a call for thrift in the mining of coal, for in a report made by the Bureau of Mines to the United States Coal Commission in July, 1923, we find the following paragraph. "During the last 10 years, when the average production of all bituminous coal in the United States was 483 million tons per annum, there was lost each year a total of approximately 250 million tons of coal. Of the total loss, approximately 140 million tons could have been avoided if better methods had been employed."

In 1912, the late Joseph A. Holmes, First Director of the Bureau of Mines, stated that, "in mining coal in the United States, probably one-third of the bituminous coal and about one-half of the anthracite coal are left in the mine, and it is estimated that since coal mining began, two billion tons of anthracite and three billion tons of bituminous coal have been left in the ground, under conditions which make future recovery highly improbable."



A MODERN COAL BREAKER

Here the coal passes through the breaker where it is sorted to size, cleaned and delivered to coal trains

Losses in mining may be considered as those which are unavoidable and those which are avoidable. Unavoidable losses are those in which it is impossible, profitably, to separate the coal completely from the impurities, either in the mine or in the coal-cleaning establishments above ground. Other unavoidable losses occur where a coal bed is too thin to work profitably, or where, in a thick bed, there are faults and disturbances, or a dangerous or treacherous roof, or where overhead water courses would render it dangerous to the men employed.

Avoidable losses are those due to improper methods of mining, bad engineering in carrying out those methods, careless cleaning of the coal, excessive blasting which blows the coal into dust, poor methods of transportation such as loading the pit cars too high, using cars with cracks or doors that let the fine coal sift out, and leaving unnecessarily large supporting pillars, the coal in which often is not recovered—this last representing one of the greatest losses in mining.

Having considered the causes of waste and the remedies therefor in the mining of coal, let us turn to the consumer and ask whether the future holds a promise of economy in the consumption of coal, comparable to that which, as we saw in our last chapter, can be realized by more scientific oil refining and more economical motors.

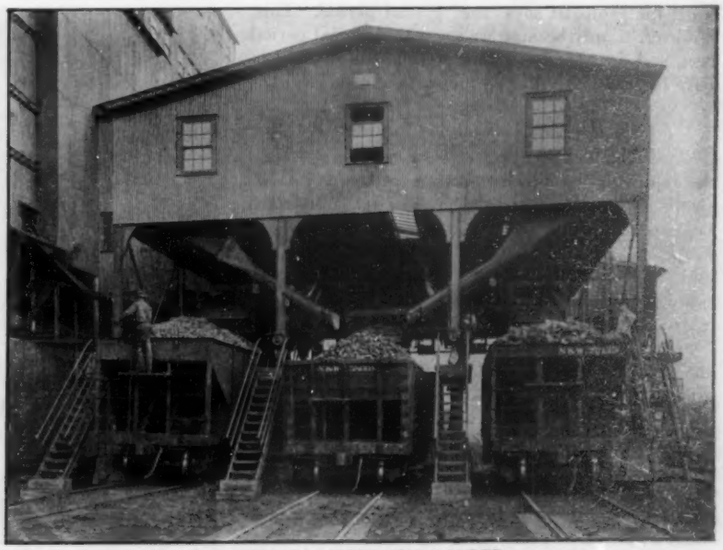
Railroads Increasing Efficiency

We are dealing in this story mainly with bituminous coal, of which, as we have seen, the United States contains some 3,500 billion tons as against 21 billion tons of anthracite. Limitations of space prevent our considering the possible economies that can be secured in the various industries which are the principal users of bituminous coal. It will suffice to show what has actually been done in the reduction of coal consumption on one particular railroad, the Delaware and Hudson, to whose president, Mr. L. F. Loree, we are indebted for the following statement. He tells us that in 1915, the typical freight locomotive of his road was using saturated steam, sliding valves and single-expansion cylinders. In moving 1,000 actual gross ton-miles, including its own weight, on a 0.5 percent grade, at average freight-train speeds, this locomotive consumed 160 pounds of coal. The first marked improvement was the application of super-heat and the substitution of piston valves for sliding valves. The fuel consumption of this engine in doing the same work was 130 pounds. In 1924, there was brought out the *Horatio Allen*, with a water-tube type of firebox, super-heated steam, and multiple-expansion cylinders with large valve and port openings. This engine, doing the same work under the same operating conditions, reduced the fuel consumption to 55 pounds of coal. Thus the same work is done with a reduction of coal consumption, within ten years, from 160 pounds to 55 pounds; and be it remembered that 25 percent of our bituminous coal is consumed on the railroads. By such scientific designing coupled with intelligent firing, similar economies in varying degrees can be secured throughout our industrial life.

¶ *In our November issue Chapter VI of this series on conservation will appear. It will deal with the deplorable extinction of some of our finest fisheries as the result of the spendthrift extravagance of the past.*

GRADING THE COAL

The coal passes on to these shaker screens in the tipple house, where it is graded to the required sizes. To the left are shown extra screens for special sizes of coal



AUTOMATIC SIZER AND LOADER

From the screens the coal is delivered to the coal cars. Here is an automatic sizer and loader, with three cars loaded, from left to right, with coal of increasing sizes

THE VALLEY OF THE SKAGIT RIVER, IN THE STATE OF WASHINGTON, IS A TYPICAL GLACIAL VALLEY, U-SHAPED IN CROSS-SECTION

Little-known Ice Ages of Great Antiquity

Most People Know of One Glacial Period. But There Were Several Before That

By Albert G. Ingalls

GEOLOGISTS used to believe that in the beginning the earth was molten and that it cooled down all through the geological ages, until comparatively recently, as geological time is reckoned, when it reached a point where the glacial period arrived. Today we know this belief to be wrong.

While most modern geologists still believe the juvenile earth was molten they know now that the glacial period which came about half a million years ago was only the last of a long series of glacial periods which began comparatively early in geological time—say, something like 500,000,000 years ago.

Usually it is the glacial period of the Pleistocene Epoch—less than a million years ago—that is meant when the geologist says "the" glacial period. This, however, is only because we know this glacial period best, and, because for a long time it was thought to have been the only one in the earth's history.

Our Present Climate Is Abnormal

To establish a proper sense of time proportion, the following ice ages are known to have occurred: In the Pleistocene Epoch the ice age just mentioned began about 500,000 years ago and ended, in our latitudes, about 25,000 years ago. In Greenland and Antarctica it has not yet ended. Other ice ages occurred in the Eocene Epoch, about 20,000,000 years ago; at the end of the Triassic Period of the "Age of Reptiles," 65,000,000 years ago; early in the Permian Period, shortly after the greatest coal-forming period, about 90,000,000 years ago; at the end of the Devonian Period ("Age of Fishes"), 120,000,000 years ago; in the Ordovician Period (marine invertebrates) 190,000,000 years ago; in the Cambrian Period, 300,000,000 years ago; and in the Archaean Era ("Age of Primal Life"), at least 500,000,000 years ago.

Life, then, has experienced many periods of cold, at least in parts of the world, and triumphantly has survived them all. In fact, many scientists believe the ice ages had much to do with hastening evolution, through increasing the struggle for existence.

Recently a notable book, semi-scientific, semi-popular, concerning ice ages, was published. "Ice Ages," in fact, is its title and its author is Professor A. P. Coleman of the University of Toronto. No such book has been available before. Professor Coleman has spent most of his life studying the evidences of past and present glaciation. He has traveled on every continent. He has probably gained a more rounded knowledge of ice ages than any living authority. "Ice Ages," (Macmillan and Company, 1926) is a summary of his life investigations.

Instead of beginning with the earliest known ice age Prof. Coleman begins with the last and then works backwards in geological time. We are not now living in the earth's normal climate, Prof. Coleman points out, but instead we are probably in the closing stages of the Pleistocene ice age. The fossil record found in the rocks proves that in the main the world's climate has been hotter than at present.

Courtesy of the American Museum of Natural History

"VARVES" IN PLEISTOCENE CLAYS, NEW JERSEY

Varves are annual layers of silt and clay deposited in lakes bordering retreating ice sheets. They are like tree rings

Perhaps we take too fully for granted our salubrious climates. Do we stop to wonder how the earth came up through half a billion years without losing its animals and plants because of some cataclysm, some even lesser accident? Life is possible only between very narrow ranges of temperature. Had those ranges been transgressed rather swiftly, life could have been destroyed as one accidentally destroys the life of an ant on the sidewalk. That a little globe like the earth, exposed on all sides to the cold of space, should have maintained its temperature within the narrow limits of 32 degrees and 190 degrees Fahrenheit for half a billion years is a most astonishing fact when we come to weigh it.

Ice Ages Aided Evolution

Yet to man and other forms of life, ice ages have been most significant. For each of them constituted a severe test for living beings. Only the fittest survived them. Evolution, nearly stagnant in the long stretches between them, must have speeded up enormously at such "hard" times. Many believe that but for the last ice age there would be no human beings on earth. There would be apes. And, suggests Prof. Coleman, "It may be that the races of civilized man are merely evanescent phenomena bound up with the bracing climates of a brief ice age, to sink, after a few more thousand years, into a state of tropical sloth and barbarism when the world shall have fallen back into its usual relaxing warmth and moisture." The Universe, the sun, even the earth does not care whether man continues to exist and advance or not.

In the last ice age, that of the Pleistocene Epoch, the ice spread over Canada and our northern states four times. The ice was doubtless more than a mile

From "Ice Ages." Courtesy of the Macmillan Company

FOSSIL VARVES OF THE ARCHAEAN ERA

These have become solid rock, turned on edge. Compare them with the unconsolidated varves on the opposite page

in vertical thickness. At each of these four advances the southern boundary of the ice stood at a different place because the four ice advances were not equal in strength.

Between each of the four advances or stages the great ice mantle melted back to the north, in some cases as far as it has at the present date—possibly farther. These were the "interglacial" stages, and some of them lasted in themselves from 30,000 to 150,000 years.

Now we go back *forty times* as far as the beginning of the ice age discussed above, to the Eocene Epoch when the ancestor of the horse was the size of a fox and had five toes, and man's ancestor was not yet even an ape. The ice age of the Eocene was, however, a minor one. Glacial drift of that age has been found in British Columbia; also at Ridgeway and Gunnison, Colorado; again in Australia and in Antarctica, in the latter of which an ice age—that of the Pleistocene Epoch—still lingers.

The ice age of the Eocene, 20,000,000 years ago, was probably limited to elevated regions and little importance would be attached to it were it not that it had so great an effect on organic evolution. It cooled the earth's warm climate and probably exterminated the giant dinosaurs that had long dominated the earth. Thus the tiny mammals inherited the earth, rapidly making the best of it, evolving into the mammals of modern days. "But for the slight dip in temperature," says Prof. Coleman, speaking of the ice age of the Eocene, "too small to be called an ice age, who knows but that some elect form of dinosaurs might now stand at the head of land animals and some pterodactyl rule the air!"

Most significant of all ice ages was that of the Permian Period about ninety million years ago. Strangely enough, its greatest extent was not at the present poles of the earth, but in India, Australia, Africa and Brazil. It was a great surprise when geologists found glacial deposits in these unexpected places, and saw that they contained the same boulders of granite that we find in our northern fields today, incorporated with what had once been glacial clay or till, into solid rock—and between such deposits of "tillite" found layers of coal formed during interglacial stages of ninety million years ago.

Prof. Coleman visited India where he was able to measure the direction of movement of an ancient glacial cap of the Permian Period by the plainly visible striations on the surface rocks of that day. "The crumbling face of the tillite," he says, "might well have been boulder clay by the shore of a Canadian river." In Africa he found much the same evidence but it was even more widespread than in India. So thoroughly consolidated was this ancient till that he says, "Attempts to break out pebbles from the matrix were usually failures, since the fractures passed through matrix and stone impartially."

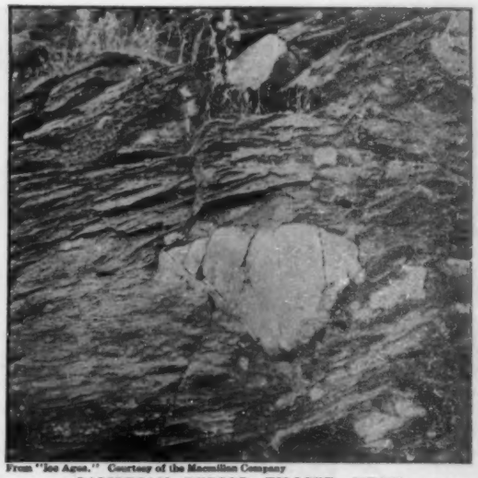
Southern Africa Under Ice!

There is ample evidence that the Permian ice age lasted through 2,000,000 years, for the African tillite accumulations are twice as thick as the tills of the last ice age. The glaciated area in Africa probably extended northward even to the present equator, thus covering all of the southern half of Africa.

In Australia the essential features are similar to those in Africa, even to the existence of interglacial beds. Here, too, the ice moved toward the equator. In Brazil, Argentina and Bolivia during some of the Permian Period, there was an ice cap 2,380 by 1,400 miles in extent. Other evidences of this ancient glaciation may be found in Nova Scotia, and at Squantum, near Boston.

"It is not surprising," continues Prof. Coleman, "that the life of the world suffered great losses during these changes of climate, clearing the way for great advances when the glacial hardships were over. But for this rude interruption possibly gigantic insects with large brains might have led the world intellectually in later times instead of vertebrates. Knowing how efficient and ruthless are the instincts of our tiny modern insects, the thought is somewhat appalling."

The ice age of the Devonian Period is not very important, and we must also skip those of Silurian, Ordovician and early Cambrian times. In the Archaean Era not long after the earth's crust was molten we find evidences of another glacial period similar in intensity to those of the Pleistocene and Permian. The most striking of these exists in Canada, where the ice of the Pleistocene, which came 500,000,000 years later, actually laid bare some of the tillites of its earliest known predecessor! Near Cobalt, famed Canadian silver mining camp, tillites with striated surfaces and angular rock fragments are to be found. Prof. Coleman states that "the glacial origin of the Cobalt tillite is as well established as that of any other ice age."



From "Ice Ages." Courtesy of the Macmillan Company

CAMBRIAN PERIOD TILLITE, UTAH

Glacial drift boulders of gneiss and quartzite in former clays three hundred million years old, now wholly consolidated

But we cannot go further. Enough evidence has been adduced to show that the earth was not, as was formerly supposed, in an uninterrupted state of warmth during its early and middle life, any more than it has been in comparatively recent times. Also that there have been many relatively short periods of cold, and that these have had an especially significant effect on the evolution of animal life, culminating in man himself.

What caused the ice ages? Of this, man is still ignorant. In his last chapter Prof. Coleman reviews the several theories that are worthy of consideration. But he says, "No theory is generally accepted. The opinions of those who have written on the subject are hopelessly in contradiction with one another and good authorities are arrayed on opposite sides."

Someone once surveyed the whole of glaciological literature and counted 77 theories that have been proposed to account for ice ages—or was it 777?

Who, then, dares add another?

From "Ice Ages." Courtesy of the Macmillan Company

ICE-WORK PERFORMED NINETY MILLION YEARS AGO

A glacier of the Permian Period striated and polished this rock in Australia exactly as the Pleistocene glaciers polished rocks only one hundred thousand years ago

From "Ice Ages." Courtesy of the Macmillan Company

STRIATED ROCKS AT KIMBERLEY, SOUTH AFRICA

The glacier that smoothed and scratched this rock might easily have done its work in Greenland yesterday, for the evidence, despite its great antiquity, is just as obvious

EXCAVATING DIRT AND REMOVING RUBBISH

The steam shovels are busily engaged in removing the earth. The derricks, some of them supported at street level on timber towers, are handling the rubbish

WORKING ON THE SHATTERED ROCK

The blasted stone is being removed by the steam shovels. Many scale pans are shown, awaiting filling and subsequent hoisting by one of the derricks at street level

Huge Job of Solid Rock Excavation

How Engineers Drilled and Blasted Through 50 Feet of Manhattan Rock to Reach a Firm Foundation for a 45-story Building

By Frank W. Skinner, Consulting Engineer

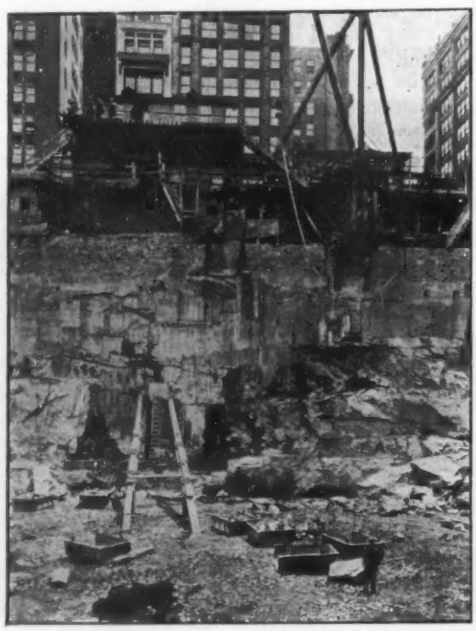
WITHIN a few months, the new tenants of offices in the 45th story of the New York Life Insurance Building, will have, from their windows, a wonderful view of a metropolitan panorama unrivaled in the world. This they will see from a point 100 feet or more directly above the place where once stood, 340 feet above the pavement, the exquisite figure of Diana that dominated the Madison Square Garden Building.

This historical structure, so inseparable from many pages of New York's history, has been ruthlessly demolished, and great quantities of the ground beneath its foundation have been removed to make way, over the whole area of a full size city block, for the substructure extending four stories below street level, of the new skyscraper. This involved the excavation of nearly 150,000 cubic yards of earth and stone from a pit 72 feet deep. The method and appliances for its safe and rapid excavation, in the heart of the great city, without injury or danger to life or property, was a worthy engineering feat. It is all the more notable because it was accomplished so easily and simply, directed by skill and experience that coordinated an army of men and the most powerful and improved machinery in efficient operation.

Pit Kept Clear of Derricks

Although few buildings in New York have four stories below the street level, yet many of them have foundations carried much deeper than this, and the latter almost invariably stop as they reach satisfactory rock bottoms. They are generally sunk by the pneumatic caisson process through the treacherous quick-sands and subterranean rivers. In the new building, such difficulties were encountered that it was necessary to penetrate nearly 50 feet through a solid bed of hard rock, hundreds of thousands of tons of which were blasted by high explosives and handled by powerful machinery that reduced hand labor to a minimum.

Because the slow demolition of the old Madison Square Garden had greatly delayed the building schedule, the contractor concentrated his energies and resources on securing the greatest rapidity and efficiency of operations. Instead of setting up derricks here and there, or perhaps building a system of railroads to convey the excavated material from all points to a central loading station, thus continually shifting his plant as the pit deepened, he kept the whole 200 by 425-foot area at all times clear of obstruction, and commanded most of it by a great battery of eight huge derricks installed around the edges of the excavation at street level. From here they reached over almost all of the working area as well as the adjacent streets, and were permanently located so as to require no movement throughout the continuation of the job. Also, around the edges of the pit, there were installed shops, tool houses, store houses, offices and a power plant, all enclosed by a high board fence protecting them and excluding the public.



IN THE DEEPEST EXCAVATION

Notice particularly the derrick on its cantilever support and the heavy shores bracing the treacherous rock stratum

At first the great derricks were seated on the old cellar floor and as the earth was excavated below them, they were mounted on timber crib work, built up as the pit deepened until the rock was exposed. Then the cribs were replaced by sturdy timber towers. The rock supporting these towers was allowed to remain, like pilasters in the face of the sides of the pit, until after all the rest of the excavation was almost completed.

At the east end of the lot, where old sidewalk vaults extended beyond the building line, heavy blocks of concrete were built in them, on the surface of the rock. These supported sets of projecting horizontal steel I-beams embedded in the upper part of the concrete and anchored to the whole mass so that it served as a 50-ton counterweight to balance the overhanging derrick placed on a little wooden tower on the extremity of the beams.

Settling of Street Guarded Against

In the bottom of the 72-foot exacavation, a timber tower was built to carry a platform at the level of the bottom of the 44-foot excavation, and trucks descending the slope from the street were loaded there with rock from the deep pit, hoisted by the cantilevered derricks. While the earth was being excavated by steam shovels, similar tower-supported platforms were built on other sides of the pit, permitting trucks on them to be loaded by the derricks without obstructing the street while they waited.

Within the boarded enclosure, all of the work was carried on by an army of sometimes as many as 325 men; three powerful steam shovels; a great number of pneumatic drills; a large fleet of five-ton motor trucks; as many huge rectangular steel "scale pans" in which the rock was loaded and hoisted by the derricks; and by the necessary equipment of power-

ful electric and gasoline pumps. These raised, to a height of 60 feet or more, the hundreds of millions of gallons of water that flowed in through the seams in the rock and were collected in two temporary wells driven down in advance of the general excavation.

Long before the base of the beautiful old campanile tower was removed by the wrecking contractor, the steam shovels were hard at work tearing out huge fragments of old foundations, concrete floors and debris, working back and forth across the lot, and gradually descending about 20 feet to the irregular, approximately horizontal surface of the bed rock. They seemed like great antedeluvian monsters bearing a whimsical resemblance to huge mud turtles with their outstretched necks and little heads. Their snapping jaws were steel-toothed buckets, which ferociously devoured earth and rubbish at the rate of a cubic yard per mouthful, and immediately disgorged it into the trucks. A constant procession of these trucks waited alongside until loaded, and then passed on to the steep incline and hastened away to deliver their loads to scows awaiting them a mile or two away in East River slips. From here these were towed to sea where they dumped their burdens in deep water.

To safeguard the vertical earth banks enclosing the upper part of the pit, the excavation around the edges was often finished or trimmed by hand. Where the earth appeared treacherous, it was immediately covered with planks. These were well braced until a massive concrete wall, seated firmly on the solid rock surface, could be built up to line the pit, and form a part of the permanent structure. This expedient eliminated a large amount of costly sheet pile driving, and effectually prevented any settling of the street.

After the surface of the hard gneiss rock was uncovered, more than 40 portable pneumatic drills were set to work drilling thousands of holes two inches in diameter, and about 12 feet deep. Then dynamite shattered the rock sufficiently to enable most of the pieces to be handled by the steam shovels, although some of them had to be drilled and blasted again. The blasting was done in strict accordance with all of the numerous municipal regulations and requirements provided to safeguard the public. The holes were blasted in groups at morning, noon and night, care being always taken to cover each group with from eight to 20 large square mats woven from heavy steel ropes, and weighing about one or two tons each. These blanketed the explosions so effectually that no fragments of flying rock injured any persons or property.

Powerful electrically driven machines with a capacity for compressing 2,500 cubic feet of air per minute were operated to maintain pressure in a huge pipe that circled the pit at street level. Vertical branches extended from the pipe down the walls of the pit, and were valved at the bottom to 50-foot lengths of flexible hose supplying the pneumatic drills.

Six Tons of Drill Bits Dressed Daily

As much of the shattered rock as possible was loaded into three-sided scale pans or boxes that were chained to the derricks and swiftly lifted out of the pit. Here their 10,000-pound contents were dumped into trucks waiting at street level. Even though their booms were 70 and 80 feet long, these great derricks failed to reach quite to the center of the lot, and a portion of the rock excavated there had to be loaded by the steam shovels into trucks in the pit, which had to climb higher and higher to street level as the bottom of the pit descended day by day.

Great care was taken to avoid swinging the derrick booms over the steam shovels, and their constant operation at so many points supplemented the shovel work, and enabled the rock to be removed as fast as it could be blasted and loaded.

The steam shovels were operated by a crew of seven men; the engineer, fireman, and five "muckers" who handled the rock and loaded the scale pans with fragments not picked up by the steam shovel buckets. One steam shovel loaded as many as 61 five-ton trucks in a single eight-hour day, and in 91 working days, all the shovels handled 5,870 truck loads of rock, nearly 28,000 cubic yards of which were sold to builders who used it chiefly for foundations, cellar walls, and the like, mostly in nearby localities on Long Island, the remainder being dumped, like the earth, at sea 25 miles away.

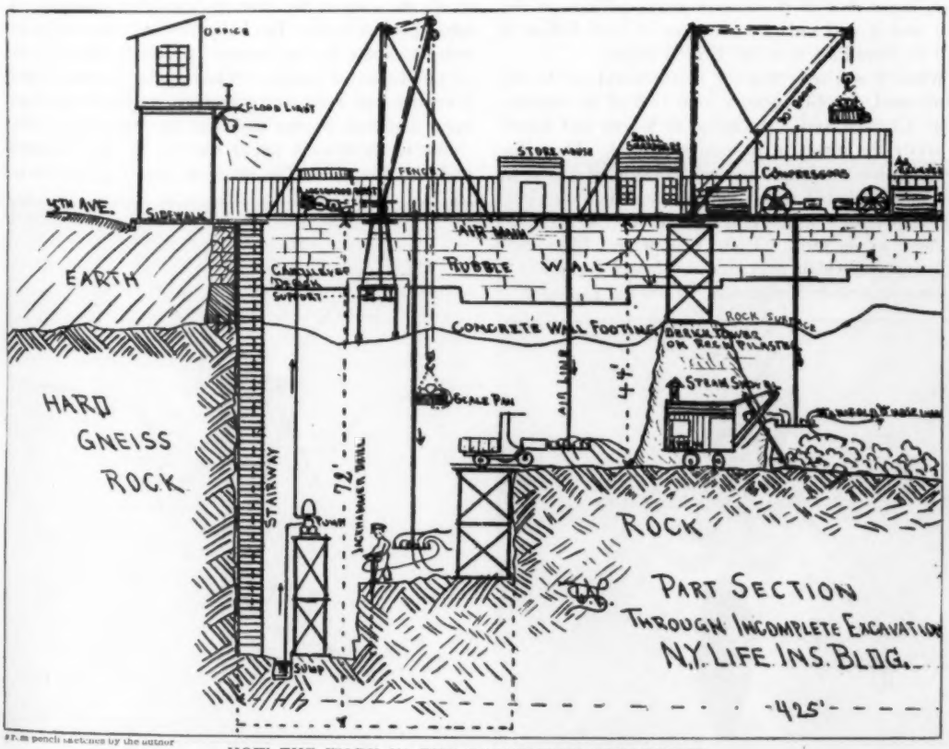
The great steel scale pans with their five-ton loads of rock were hoisted from the floor pit to the trucks at street level at a speed of 350 feet per minute. Six or eight of the scale pans for each derrick were available for filling simultaneously in different difficult positions so that the rock did not have to be carried to them, and one was always ready as quickly as another one was hoisted and dumped.

Each of the derricks was equipped with a powerful double-drum hoisting engine, and an additional smaller engine for swinging the long heavy boom while the load ascended, thus requiring a minimum of operating time.

The hard rock dulled the six-point drill bits so rapidly that it required six men and two sharpening machines to dress about six tons of them daily. The steam shovels, consuming a ton and a quarter of coke a day, were so sturdy that this hardest of services only entailed a cost of a little less than one cent per yard of rock handled, for repairs, which altogether, cost less than 123 dollars in three months. At night, although only the pumps were at work, the entire excavation was brilliantly illuminated by eight 1,000-watt flood lights.

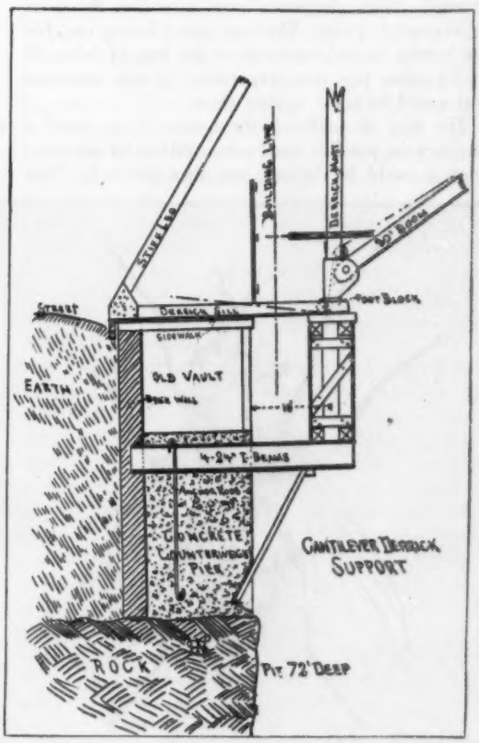
The bottom of the finished pit is at two elevations; one of them 44 feet, and the other 72 feet below street level. It will be lined with waterproof concrete, and will afford ideal foundation for the hundreds of thousands of ton loads from the steel columns in the lofty skeleton of one of the tallest buildings in the world.

Mr. Skinner has prepared another article for us, and it deals with the construction of what is said to be the largest storm sewer in the world. This article will appear in a forthcoming issue and will, of course, be fully illustrated.



HOW THE WORK IN THE EXCAVATION PROGRESSED

The various problems that the engineers had to solve are graphically shown in the above illustration. The strata of dirt and rock which had to be removed are all indicated. The motor trucks were driven down a ramp to the pit



AN ENGINEERING FEAT

Cantilever derricks at the eastern end were supported by the novel counterweight and bracing system here shown

The Scourge of the Japanese Beetle

Bug Fights Bug in an Attempt to Rid Certain Eastern States of an Insect Blight that Threatens to Destroy Many Plant Growths

By J. L. Miller

WHENEVER a new insect pest invades our fields, the entomologists sent forth to exterminate or control it, wage war not only with poisons and powders and sprays, but with armies of beneficial bugs. They go into the country from whence the pest has been imported—often to the far corners of the earth—to study the enemies that kill and harrow the pest in its native land. These they colonize alongside of the devastating insect and so curtail its enormous rate of increase.

Such are the methods being used against our latest pest—the Japanese beetle—an insect which has been termed by some entomologists as the most devastating that has ever threatened the fields of any country. It is a beautiful green and gold creature about the size of a potato bug, and it ravages almost every green thing. Indeed, over 212 varieties of trees and plants have been cataloged as providing food for this indiscriminating insect. It was accidentally introduced into New Jersey in grub form in nursery importations prior to 1916. It has since spread over 2,400 miles of land—over a territory having Riverton in New Jersey as a center, and embracing a section of Pennsylvania about Philadelphia and a corner of Delaware.

Kept in Control in Japan

The significance of the beetle was recognized from the beginning. The fight against it was taken up by the national government and by the states of New Jersey and Pennsylvania. At first it was imagined that it might be possible to stamp out the beetle entirely by intensive spraying and by cyaniding the ground. Boys also were hired to collect the pests at so much a quart. The fight was a losing one, for the beetles spread outwards at the rate of from 10 to 15 miles per year, regardless of any measures that could be taken against them.

The idea of confining the beetles in as small a territory as possible until some method of adequate control could be devised, was then adopted. That

THE JAPANESE BEETLE
An enlarged view of the destructive Popillia japonica

is the reason why every road leading out of the beetle territory is patrolled by government inspectors from June to October—the months of activity for the pest. Every automobile is stopped and contraband produce or plants are confiscated. Produce may be shipped out of the beetle territory upon inspection, but soil and manure and other materials must be treated in such a manner as to destroy all insects, grubs or eggs that may be present. The quarantine has been very successful in preventing the long distance spread of the insect. It is, however, impossible to check the natural advance of the pest and it will only be a matter of time before it will be found all over the United States.

When it was seen that the beetle could not be exterminated, the Government sent two of its experts, C. P. Clausen and J. L. King, to Korea and Japan to study the insect in its native habitat. They discovered that the beetle was not considered a pest in Japan and that it was kept in control by various parasites which either destroyed the beetle itself or its grub. There is a perfect balance in nature which prevents any insect from becoming unduly numerous. When the Japanese beetle was introduced into the United States, the hereditary enemies were left behind and for once in all the ages of its existence, every egg developed into a full-grown adult instead of perhaps half a dozen out of every hundred.

The problem was to discover the deadliest enemies of the beetle and then introduce them into the United States. Various destroyers of the pest were cataloged and the work of collecting larvae and adults begun. During the past four years, consignments of these beneficial insects have been arriving at the Riverton laboratory every few weeks or months. The parasites or their grubs are collected by Korean women and boys, packed in moss-filled match boxes and shipped, as is fruit, in a cooled car or ship. Some of the imported insects were unable to stand the climate of New Jersey and died. Others thrived and have been released upon the beetle-infested territory.

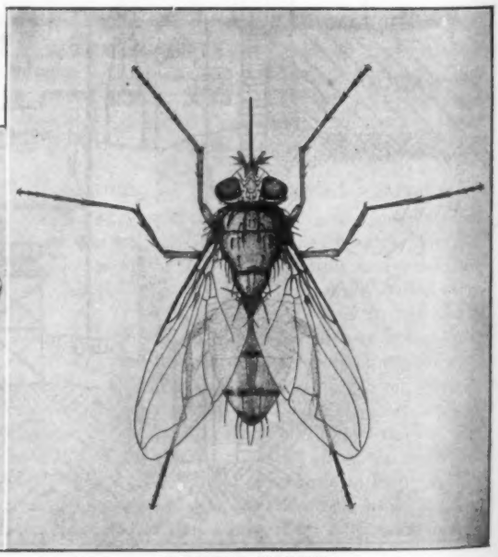
Its Foes Imported Also

It was soon discovered that in Japan, the chief foe of the Japanese beetle was an insect known as the *Centeter cinerea*, a fly belonging to the tachinid group. This creature, somewhat smaller than the ordinary housefly, has minute greyish stripes running horizontally along its body and is responsible for the death of 50 percent of the Japanese beetles in their original habitat. This fly lays several eggs, scarcely larger than the point of a pin, directly behind the head of the beetle. In a short while they hatch and the tiny grubs bore into the body of the host, filling themselves with beetle meat. The beetle becomes sick and buries itself in the ground, dying in six days from the time the *Centeter cinerea* laid eggs upon its body. The baby *Centeter cinerea*, however, does not die but pupates within the dead body of the Japanese beetle. When spring comes again it emerges as a fly and goes forth to lay more eggs upon Japanese beetles and thus continues the cycle.

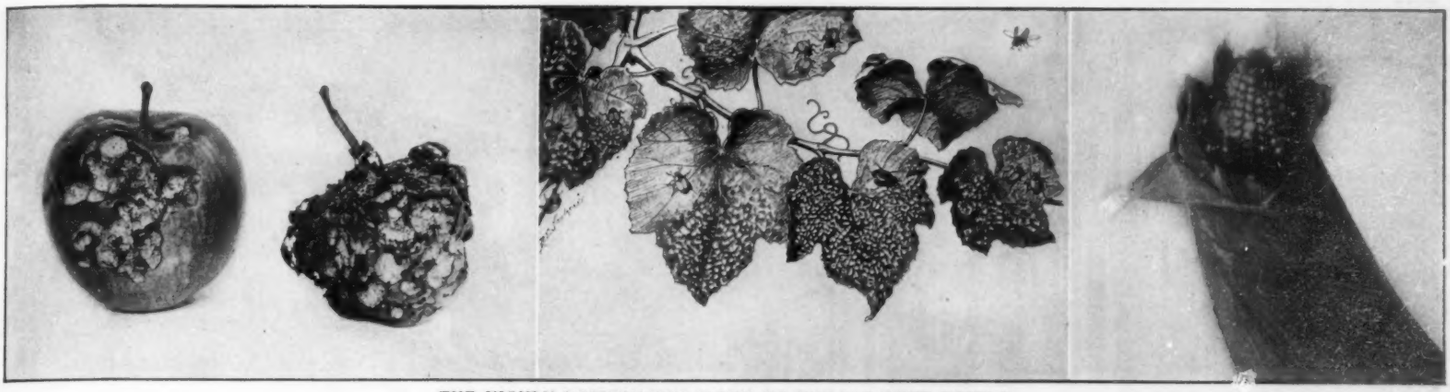
We learn from a paper written by Mr. Clausen and Mr. King that, "as many as fourteen eggs were

CENTETER CINEREA
This is one of the most important of the parasites that limit the rate of increase of the Japanese beetle

TIPHIA POPILLIAVARA
This is the Japanese parasitic wasp that is being used in the Japanese beetle war



PROSENA SIBERITA
This parasite, the dixid fly, is responsible for killing 10 to 12 percent of the Japanese beetle in Japan



THE HIGHLY DESTRUCTIVE WORK OF THE JAPANESE BEETLE

LEFT: *An attack has been centered on an apple.* CENTER: *The beetles are engaged in devouring grape leaves.* RIGHT: *An ear of corn partially destroyed*

found on a single beetle in the field, and of all eggs laid, from 70 to 99 percent were upon female beetles. During the alternate years 1921 and 1923, the parasitism was slightly less than 50 percent, with between 98 and 100 percent of the eggs on female beetles. At Koiwai where the beetle is fairly abundant each year, the parasitism ranges from 75 to over 90 percent, as based on four years' observations. During the past three seasons, a total of 296,000 parasitized beetles have been collected, as many as 56,000 having been secured in a single day, and the puparia from these shipped to New Jersey." Mr. King says that the abundance of beetles and general conditions are similar to those in New Jersey but that it is very doubtful if the percentage of parasitism will be obtained in this country.

Various Enemies of the Pest

The *Centeter cinerea* has shown itself very well adapted to the climate of the United States. The first brood was set free upon the beetle-infested area in 1921, followed by a second in 1922 and by a third in 1923. Later, a separate colony was set up in Torresdale, Pennsylvania. A recent check up on this parasite shows that it has already spread over 16 square miles of territory—an even greater rate of progress than the beetle itself.

A second link in the chain of parasites which is being built up against the Japanese beetle is the *Prosena siberita* or dixid fly—a parasite responsible for the death of from 10 to 12 percent of the pests in Japan. Like the *Centeter cinerea* it, too, resembles a house-fly but is somewhat larger. It, however, does not attack the adult beetle but attacks the grubs hidden in the earth. When springtime comes, it drops from 600 to 700 living larvae or maggots upon the ground. These, guided by the sense of smell, seek out the grubs of the Japanese beetle. They attach themselves to the trachea or breathing tube of the developing insect and immediately start growth, deriving their air therefrom. They pass the winter within the bodies of their victims and in spring begin to increase in size. This takes place so rapidly and so great a quantity of the body fluids of the host are consumed, that the young Japanese beetle dies. The *Prosena siberita* then pupates for about 18 days, after which it emerges as an adult fly.

This parasite has likewise been found to thrive in the United States. Last year the first colony was set free on a golf green near Moorestown, New Jersey and this year another batch of 4,000 individuals has been released. Golf courses have invariably been selected as colonization places for the *Prosena siberita* mainly because such places, being undisturbed by the plough, always have the greatest infestation of grubs—sometimes as many as a thousand or more to the square yard.

A third parasite of which big things are expected by the scientists is a small Japanese wasp—*Tiphia popilliavara*—with a small and dark but business-like kind of body. It, too, attacks the grub rather than the adult itself. The wasp, guided by its keen sense of smell, burrows down into the ground like a little drill until it reaches the grub of the Japanese beetle. Rendering it temporarily impotent by stinging, it lays an egg upon its body. Within seven days the wasp grub hatches. It clings to the baby beetle with its mouth and sucks so great a quantity of its vital juices that the beetle dies after a few weeks. The little wasp then spins a silken cocoon and awaits the coming of spring.

A fourth enemy of the Japanese beetle which was brought to the United States but which failed entirely because it was unable to adapt itself to conditions, was a predacious carabid beetle—*Craspedonatus tibialis*. This insect, which is found in great quantities at a spot a few miles from Tokyo, attacks and kills the Japanese beetle wherever found. Seventeen thousand of these beetles were shipped to Riverton, New Jersey, but none lived. Perhaps it was the climate or maybe the heavier soil. At any rate, they died.

Other possible destroyers of the Japanese beetle are being experimented with and studied both at the Riverton laboratory and by Mr. Clausen. Loren B. Smith, entomologist in charge of the Japanese beetle project, desires a whole chain of parasites so that if one or more fails, others can take their places.

KILLING A BEETLE GRUB

The grub of a Japanese wasp attaches itself to the beetle grub in the manner shown

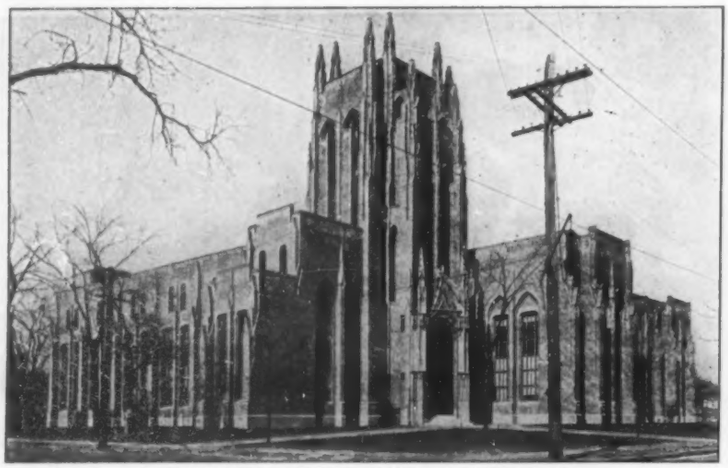
In summarizing the work in Japan and Korea during the past four years it may be stated that eleven species of parasites have thus far been found which normally do or can develop on *Popillia japonica* (Japanese beetle), three of these being upon adult beetles and the remaining eight upon or in grubs. With the exception of one Tiphia, all of these have been or will be introduced in numbers sufficient to establish them, if such is possible. In general, the work is very encouraging, and if an effectiveness equal to that in the native home of *Popillia japonica* is secured, it should go far toward reducing the ravages of the beetle.

No Danger from Its Various Parasites

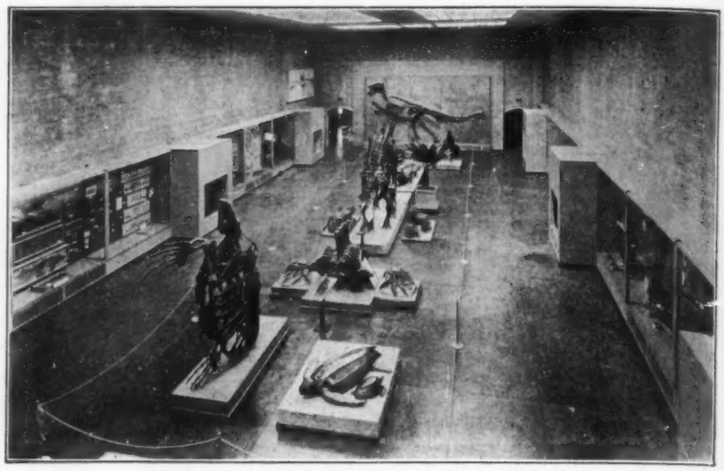
But may not the various parasites develop into worse pests than the Japanese beetle itself? Nothing is a more remote possibility. Those in charge of the introduction of the parasites would be poor scientists indeed, were they to guess at so important a question. Experiments are conducted in the laboratory to determine just how the insects will react to their new conditions. Take the example of the *Centeter cinerea*. Its eggs can only be laid upon the back of the Japanese beetle, and without the Japanese beetle it must perish. When it is a fly, it lives upon the sweet juices of flowers and is perfectly harmless. The *Prosena siberita* is similarly dependent. The Japanese wasp likewise requires the grub of the beetle to rear its young and even were it to adapt itself to other kinds of grubs—which does not seem probable, no harm would result. Incidentally, the introduction of parasites has its difficulties. The *Centeter cinerea*, itself a parasite, had to be divested of the parasite which would have destroyed it in turn.

A second opposition which one sometimes hears voiced against the introduction of the parasites has to do with a belief that nature will find a way out and that she will, of her own accord, restore a balance between the pest and its destroyers. Thus the fight is vain and useless. Yes, nature probably would equalize things in time but she is too slow about it, and before her work were accomplished, millions if not billions of dollars worth of crops might be destroyed. She has already done this very thing in several instances. During the 70's and 80's of the last century the cabbage butterfly and the potato bug were considered pests of the first magnitude. Today, they still exist but no one ever stops growing cabbage or potatoes on account of them.

Do you know what the term "arthropod" means? It is a word that should be a common part of the vocabulary of all nature students. It will be explained in full in our November issue.



NEW MUSEUM AT NEW HAVEN, CONNECTICUT
The institution is sixty years old but the building is brand new



THE GREAT HALL OF THE PEABODY MUSEUM
Most museums fatigue the visitor with detail. Yale avoided this

Yale's Great New Museum of Evolution

The World Has Many Museums, But the Peabody Museum at Yale Is Unique—There Is No Other Like It

By Richard Swann Lull, Ph.D. Sc.D.
Professor of Paleontology, Director of the Peabody Museum, Yale University

A MONUMENT to those early pioneers of science—Othniel C. Marsh, Addison E. Verrill, James D. Dana—first curators of the Yale collections which rank among the finest in the world—was dedicated at the end of last year in the form of a magnificent building, the new Peabody Museum.

Built for the service of the university, the public and the world of science in its larger sense, the importance of this event will be appreciated when it is realized that this institution—the history of which falls into three distinct periods—has seen a half century of formative life. It was founded in 1866.

Then came a period of apparent quiescence, from 1917 to 1925, due to the inadequacy of the old building and the necessity for clearing its site for the Harkness Memorial quadrangle. The institution, at any rate from the public viewpoint, had apparently ceased to exist, for the collections were largely inaccessibly stored, awaiting their adequate rehousing.

The period of apparent dormancy was prolonged, partly by the Great War, which made other activity relatively of so much greater immediate moment, and partly by the hope that mounting construction prices would go over the top and return more nearly to a prewar level. After seven such lean years, signs of approaching activity could be seen—preparation and completion of plans, and their fruition in the new building; moving, arrangement and installation of the collections.

The arrangement of the collections in the Peabody Museum is such as to fulfill a three-fold purpose: first, collegiate instruction, to serve as tangible illustrations of class-room discussions, covering fields of interest not only to scientific students but to those of the humanities as well, for in the various exhibits, educational values are everywhere emphasized; second, for the instruction of the general public. New Haven, a city of some 170,000 inhabitants, has no other museum of natural history. This means not alone the impressing of the ordinary adult, citizen or alien, but also, third, instruction to school children, either direct or indirect, in cooperation with their regular instructors. In other words, there is a children's department, ably administered, which after but three months of practical life is already a strongly-felt factor in the instruction of youth.

The function of productive research has naturally somewhat abated during the past year, when all the energies of the staff were turned to intensive installation; but it will be revived, it is hoped, on a larger scale than ever. There is yet much investigation to be done with the collections. However, it can hardly be so spectacular as in the old days, for the pioneers, Marsh and Verrill, were publishing paper after paper, each the notice of an amazing discovery in a virgin field which has since been exploited so fully that new discoveries are not easily made. These were in every way comparable to the results of the American Museum's present-day expeditions in far Mongolia.

From Unicell to Man

The Gothic design of the Peabody Museum, with its lovely canopied porch, gives it an atmosphere that is rare among buildings devoted to such a purpose. The somewhat irregular relationship of the various portions serves to accentuate the beauty of the fabric. This made it possible to plan an exhibition sequence which compels the visitor to be orderly in his study of the whole, rather than to permit random wandering with a confused notion of what it all means. This is especially true of the first or main exhibition floor; less so of the third.

In the first hall to be entered, invertebrate fossils are displayed, arranged stratigraphically in their orderly historic sequence, with explanatory labels and diagrams and maps showing the changing coast line of North America in each successive era.

The entire remainder of the lower floor has been given over to an exposition of the continuity of animal life, from the lowest unicellular forms, whose minute size necessitates the use of enlarged models rather than actual specimens for their exposition, to man. In this museum, however, for the first time, at any rate in America, material is drawn from the entire collection of animals, both existing and extinct, for it is manifestly impossible to tell a complete story of continuity if one excludes either the one or the other series. Some groups are known to be ancient of which there is no fossil record, others are entirely extinct, but betray relationships between existing orders which would otherwise not be demonstrable. This exhibit also makes possible ready comparison of ancient types with those now alive and thus clarifies the student's understanding of the former.

Due in part to accidents of preserval, in part to past dominance, the Protozoa and insects will be largely recent and the reptiles largely fossil, but exhibits are fairly balanced, in so far as the collections permit. The remainder of the wing contains the invertebrate phyla, whereas the Great Hall displays the first of the vertebrates, fishes, amphibians, reptiles, and birds; the third and fourth halls the mammals; and the fifth the higher primates, including man.

Among other notable special exhibits in the Invertebrate Hall will be a display of Permian Period insects collected in Kansas by Curator Dunbar in 1921 and now in process of detailed scientific study by Dr. Tillyard of Cawthron Institute, New Zealand. This collection, which is by far the largest ever assembled from this remote geological period, contains many admirably preserved forms which were unknown to science, thus clarifying our conception of insect relationships.

Another special collection has been prepared by Curator Emeritus Charles Schuchert, long identified with the museum as Curator and Secretary of the Board of Trustees. These are lamp shells, or Brachiopods, which, together with certain beautiful preparations by his predecessor, Professor Charles Beecher, demonstrate within the one group all aspects of the evolutionary hypothesis.

The Great Hall is in reality a closed-in court, flanked on three sides by the remainder of the building and extending up through the height of two stories, with a gallery at the southern end given over to fossil footprints and other phenomena of the Connecticut Valley Triassic Period rocks. Here the great dinosaurs, all original type specimens, in which the Museum is especially rich, will ultimately be mounted; in fact, a few already are displayed.

The flying pterodactyl from the Sohlenhofen lime-

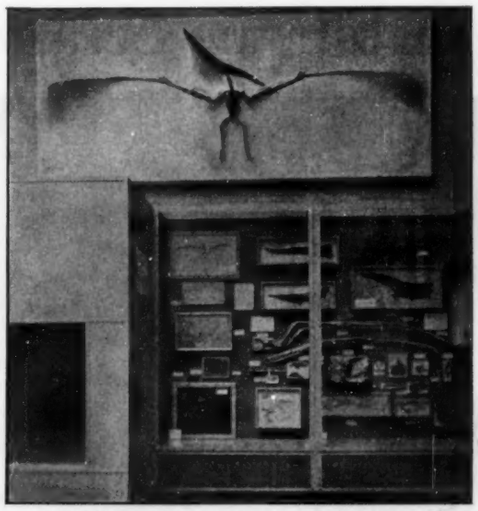
stone of Bavaria, *Rhamphorhynchus phyllurus*, the first in which the wing membranes were preserved, shows the minute wrinklings of the delicate structure with marvelous clarity, and that to the unaided vision with no especial treatment other than that given to every other specimen in the room. Here, as elsewhere, the most careful selection of material has been made, not for its rarity, but to demonstrate a truth or essential fact bearing on the majestic hypothesis which accounts for the existence of organisms as part of an orderly developmental creation. As a consequence, but a fifth part of the great collection of fossil vertebrates is shown, the remainder being in systematic storage in the basement where it will be readily accessible for further detailed research.

Indeed it may be said that that which is shown is already known to science, and much of it has formed the source of our knowledge and has served as illustrative material, descriptive and pictorial, in books and treatises the world over. Here are all save one of the Connecticut Valley Triassic dinosaurs, here some of the most remarkably preserved primitive reptiles from rocks of the Permian Period of the southwest, here the most venerable footprint of a terrestrial vertebrate thus far discovered, and here the toothed birds which inspired Marsh's memorable memoir and called from Charles Darwin a most remarkable testimony of their value as evolutionary evidences.

Specimens Praised by Huxley

The Mammalian Halls are also rich in classic material, such as the tiny jaws and teeth of early mammals which existed, but did not evolve materially, during the age-long period of reptilian dominance. Of these the museum contains perhaps two-thirds of the known specimens of the world, announced years ago by Professor Marsh, but now the source of a most illuminative research on the entire Mesozoic Era group.

The classic horse collection is equalled if not exceeded in the degree of completeness of individual specimens in one or two other places, but it has the unique distinction which can never be taken from it of being the first demonstration of the phylogeny or evolutionary history of a race! These specimens Huxley studied during a memorable visit to America and eulogized, as did Darwin the ancient birds. Throughout these halls the latest museum practice is in evidence such as the absence of shelving, fewness of specimens, selected, as has been said, for their instructional values, carefully thought-out labels, and, above all, attractiveness and atmosphere to interest and inspire rather than to weary and



PTERODACTYL, ANCIENT FLYING REPTILE
Modern birds are modified reptiles, not descended from these

confuse. The value of the museum is thus enhanced.

The Hall of Man is not especially unique, other than in the assemblage in one place of evolutionary evidences derived from comparative anatomy, the developmental history, and the fossil record, which are usually so widely scattered that their corroborative testimony is not readily comparable. One case contains a series of casts showing the physical evolution of fossil man, while in another the cultural evolution is shown by actual material, part of the very extensive collections of prehistoric archaeology gathered mainly in Europe by G. G. MacCurdy, the Curator of Anthropology in the Museum.

This hall also contains an exposition of the so-called evolutionary factors upon which the fabric of the hypothesis is based—heredity, variation, coloration, mimicry, behavior under domestication, and the like.

In three of the halls one sees many instances of the munificence of another more recent donor, Thomas Cardeza, who, in 1922, gave his entire collection of game trophies, heads, horns, skulls, and tusks to the number of several hundred. These serve admirably, not only by their decorative beauty, but by their scientific value, to supplement the older collection of mammalian life.

Above the entrance rotunda is a small hall in which the celestial phenomena are displayed in the form of illuminated transparencies of the heavenly bodies and meteorites representing a great number of important falls. These include a large series of stone and iron meteorites collected by H. A. Newton, Professor of Mathematics at Yale from 1855 until 1896 and one of the highest authorities on the whole subject of "shooting stars." Here is also a remarkable Aztec calendar stone, one of the three which are known, the others being in the Mexican National Museum and at Oaxaca.

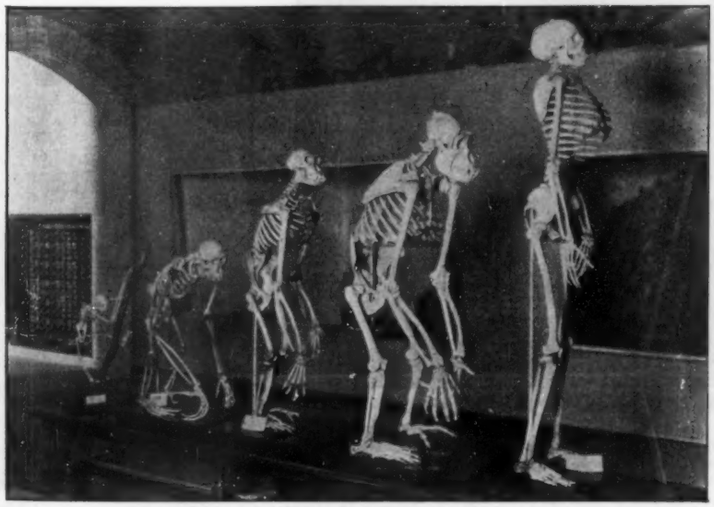
From the ceiling of this hall, through a well-like aperture, will be suspended a pendulum to repeat daily the classic experiment of Foucault in 1851 in the Panthéon at Paris and thus demonstrate visually the phenomenon of earth rotation. Farther down in the crypt beneath the entrance hall is an excellent seismograph. The importance of this, which is the second of the only two stations in all New England, is at once evident. Another hall contains about half of the great collection of minerals, some of which formed the initial gathering made by Benjamin Silliman in 1803, out of which the institution was destined to grow. The minerals are noted, not alone for the completeness of the series, and the rarity and great beauty of some of the specimens, but for the fact that here again the collection contains type material, the basis of new description and subsequent research.

There are two Halls of Zoology, in one of which the economic aspect of that science is stressed, and in the other, local associations of birds, reptiles, and other groups, including invertebrates. The Hall of Economic Zoology also has a portion set apart for the instruction of special groups of children.

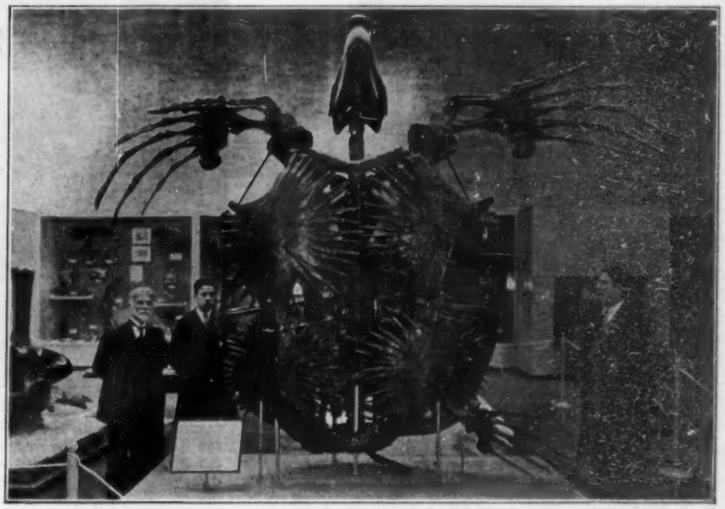
A Museum for All

Perhaps one-half of the collections pertaining to man are to be found in the hall of Ethnology, under the special care of G. G. MacCurdy, who has served as Curator since 1902. Collections of more than usual interest are here, among which are those of prehistoric objects from the Province of Chiriqui, Panama, the Beadle Collection from southern California, the Mosely Collection of Indian Basketry, the Grinnell and Bigelow Collections pertaining to the Plains Indians, and that collected by the Yale Peruvian Expeditions under the leadership of Senator Hiram Bingham. New England is also well represented, especially, and fittingly, Connecticut. A very instructive synoptic series from Europe represents the especial field of research of the Curator.

This briefly describes Yale's newly housed museum, which has already been visited by tens of thousands of people to their enjoyment, and, it is hoped, to their intellectual and spiritual uplifting. We trust that in the days to come it will prove yet more valuable to the many who are destined to come, for it holds out a welcome to all lovers of nature.



PRIMATE SKELETONS IN THE HALL OF MAN
LEFT TO RIGHT: *Gibbon, orang, chimpanzee, gorilla and* Homo sapiens



LARGEST TURTLE IN THE WORLD
Turtles evolved just before the age of reptiles, in the Permian Period

From the Scrap-book of Science—Came

Wide World

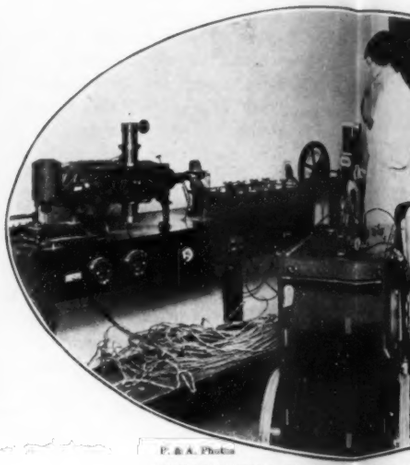
THE MASK OF TUT-ANKH-AMEN

This covered the head and shoulders of the King's mummy. It is made of beaten gold, inlaid with lapis lazuli, felspar, carnelian, calcite, obsidian and polychrome glass. Some of these minerals are quite rare, while others such as felspar and calcite are commonplace but nevertheless beautiful

International Newsreel

ACCURATE TO 1/7200TH OF A DEGREE

Dr. Lewis V. Judson of the U. S. Bureau of Standards, with a new circular dividing engine just purchased by the Bureau. It is believed to be the most precise now obtainable for the graduation of circles, being accurate to one-half of one second of arc. It will be used for the graduation of precision theodolites and instruments used by various scientific departments of the Government



P. & A. Photos

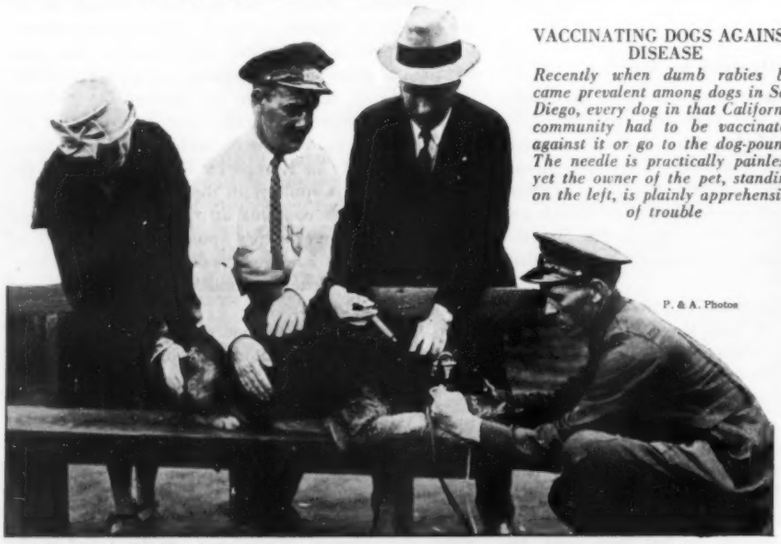
INSTRUMENT PERMITS GROUP

The new electro-cardiograph and "radio-stethoscope" at heart beats and amplifies them so that several physi

Courtesy of the General Electric Company

MAMMOTH TURBINE CASTING

Assembly of the casting of the low-pressure element of a 77,000-kilowatt, cross-compound steam turbine. It weighs fifty tons and is sixteen feet in diameter



P. & A. Photos

VACCINATING DOGS AGAINST DISEASE

Recently when dumb rabies became prevalent among dogs in San Diego, every dog in that California community had to be vaccinated against it or go to the dog-pound. The needle is practically painless, yet the owner of the pet, standing on the left, is plainly apprehensive of trouble

P. & A. Photos

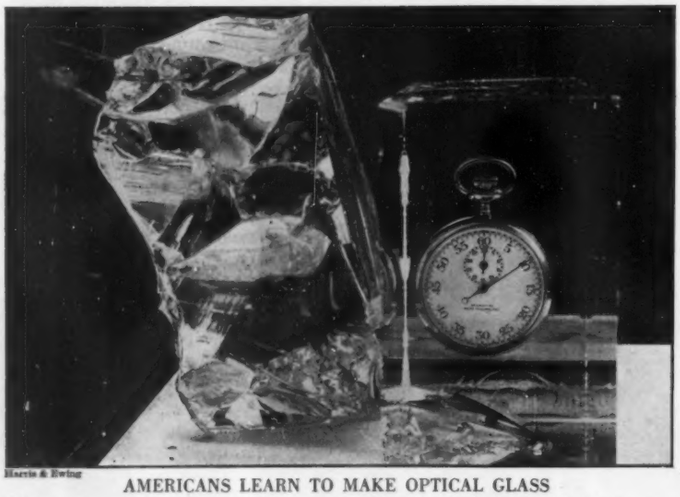
CONCENTRATION

Tests recently made at the Department of University of Chicago indicated that students and more accurately when their muscl

Wide World

UNSANITARY

Recently, London workmen unearthed at a depth of three feet a wooden water pipe, laid in the Seventeenth Century. It is said that such water mains spread disease



Harris & Ewing

AMERICANS LEARN TO MAKE OPTICAL GLASS

Optical glass made at the U. S. Bureau of Standards. Until the World War began, the United States imported its optical glass from Germany. With the German supply cut off, American scientists began learning to make optical glass themselves and within a few months were successful. Much optical glass is now being made in the United States. The stop-watch shown above was photographed through a piece of optical glass nine inches thick, made at the Bureau of Standards. Such a block, before grinding and polishing, is shown on the left, illustrating the startling difference between the raw, unfinished material and the finished product

Harris & Ewing

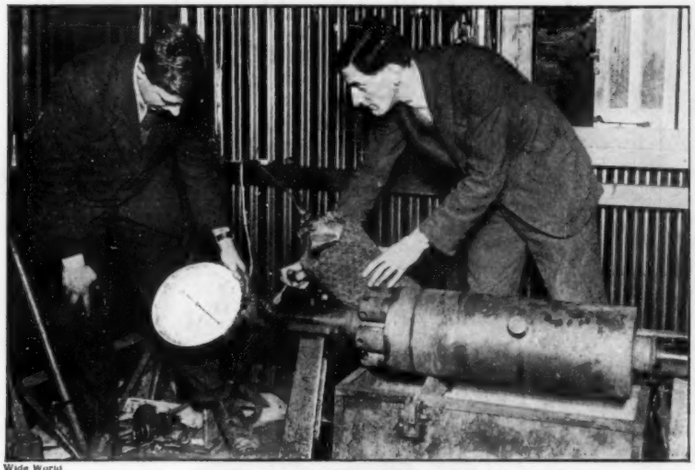
UNDERSTANDS BATTERI

George W. Vinal, Government battery expert of the Un ards, where he is the head of a section. Hi book, "Sto

Camera Shots of Scientific Happenings

ERMITS GROUP DIAGNOSIS

lio-stethoscope" at a Chicago hospital. It records so that several physicians can diagnose them



Wide World

LIQUID FUEL FROM COAL

Making laboratory tests at Birmingham University, England, on the Bergius process of "liquification" of coal. Dr. Bergius, a German, claims a ton of coal will yield half a ton of oil for motor fuel; also valuable solids. The process takes place at a pressure of 1,800 to 2,250 pounds per square inch, and at a temperature of about 800 degrees, Fahrenheit

H. J. Shepstone

NO TRESPASSING

A Greek inscription of the Fifth Century, recently discovered near the aqueduct which conveyed water into Jerusalem. It contains a warning, both against trespass and planting crops within fifteen "podos" (fifteen feet) of the conduit. To make sure the peasant should not plead ignorance of the distance, the "foot," 12 1/16 inches long, was engraved on the stone

ONCENTRATION

the Department of Psychology of the dicated that students could think faster ely when their muscles are tense

4,692 FEET PER SECOND

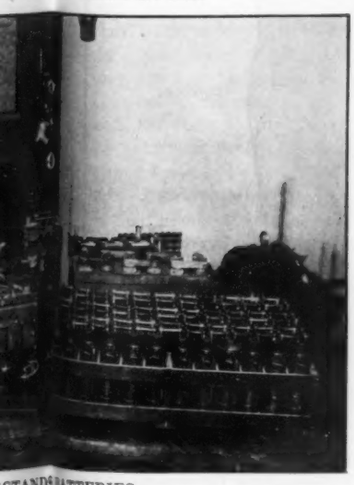
P. T. Russell of the Washington Navy Yard, who developed this apparatus for quickly measuring the depth of the ocean. The principle is simple. A sound is directed downward from the ship, strikes bottom and is reflected. The speed of sound in water being known, the distance of depth may easily be determined

P. & A. Photos

Wide World

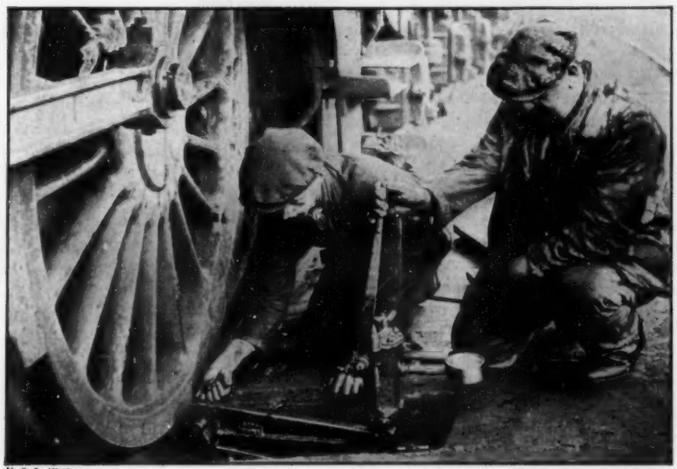
TESTING ALLOYS

The extensometer at the U. S. Bureau of Standards, Washington, D. C., testing alloys under heavy stress. The amount of distortion of the alloy may be determined within one four-millionth of an inch



STANDS BATTERIES

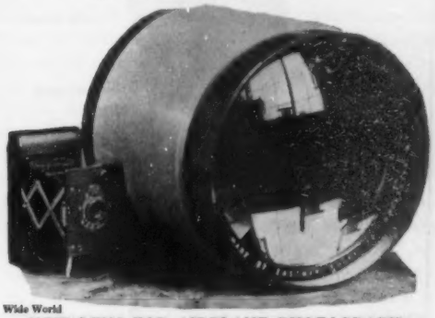
tery expert of the United States Bureau of Standtion. His book, "Storage Batteries," is well-known



P. & A. Photos

NEW WEIGHING SYSTEM FOR LOCOMOTIVES

A British device for weighing locomotives, which has been installed in the King's Cross locomotive sheds in London. It consists of a small hydraulic jack which is placed in turn under each wheel of the locomotive. The several weights are then added. Some rather large locomotives are now being employed on some of the British and European railroads. Americans who used to smile at the diminutive locomotives of the Old World will now meet with frequent surprise, since some of the newer locomotives weigh over 100 tons. Express trains in England average faster than in the United States, another fact which may cause some surprise



Wide World

NEW LENS FOR AIRPLANE PHOTOGRAPH

This 45-pound lens, nine inches thick, was recently made for the U. S. Army Service. Through it the city of Detroit was photographed from a distance of 210 miles Above, the lens is compared with a pocket camera

What Asthma and Hay-fever Are

Medical Science is No Longer Baffled by These Peculiar Diseases

By Grafton Tyler Brown, B.S., M.D.

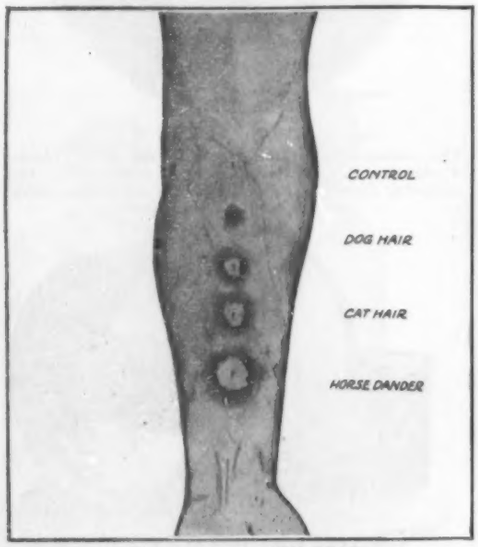
DOUBTLESS some of the readers of the Scientific American have passed through the throes of asthma or hay-fever. If so, they are all-too-familiar with the trying symptoms of itching, teary eyes, running nose, sneezing, in the case of hay-fever, and the uncomfortable, sometimes terrifying shortness of breath in asthma cases. In writing on this subject, I realize that I am not treading on virgin soil, as evidenced by the increasing number of articles appearing in the lay press. Unfortunately, however, much that has thus been written is not true and is apt to be misleading.

Since I am about to advocate the cutaneous or skin test for both asthma and hay-fever, and the treatment of such cases by the injection under the skin of certain proteins, I will explain briefly just how this treatment was discovered and how it came to be recognized by leading physicians.

Anaphylaxis Discovered Accidentally

In 1902, Charles Richet injected a dog with some poisonous substance. This injection had no apparent harmful effect. Twenty-two days later he repeated the injection, using exactly the same dose, with the idea in mind of giving gradually-increasing doses in the future, and thus producing a condition of prophylaxis, or immunity, in the dog to that particular poison. Much to his surpise, however, before he had hardly completed the injection, the dog was taken suddenly ill and died within 35 minutes. As this condition was the exact opposite of prophylaxis, he christened it *anaphylaxis*. What had happened was, that the first dose had sensitized the dog to that particular poison, while the second dose had caused sufficient shock to produce death.

Animal experimentation was next carried on by different investigators in many countries, and we have thus come to know that the interesting and varied phenomena of anaphylaxis are due to sensitization to some foreign protein. The first dose or injection of foreign protein, which produces the condition of sensitization, is known as the "sensitizing dose." Following the first or sensitizing dose, there



REACTIONS TO SKIN TESTS

The patient is being tested with the various substances indicated above. The reaction to each is indicated by the appearance of the skin around its cut

SPECIMENS OF RAGWEED

These plants, Ambrosia trifida *and* Ambrosia artemisaefolia, *are often the cause of asthma and hay-fever, although they are not always the offenders*

is what may be termed an incubation period of approximately ten days, during which the blood and tissues of the animal are endeavoring to form antibodies, in response to the stimulus of the foreign protein. Any further injections given during this so-called incubation period will have no effect other than to prolong the incubation period.

Meltzer, in 1910, noted that during the experimental anaphylactic shock, guinea-pigs manifested asthmatic symptoms. He suggested that asthma in human beings was likewise due to anaphylaxis or protein sensitization. A guinea-pig that has been sensitized to horse serum, will react to horse serum, but not to cow serum; and vice-versa. In other words, protein sensitization is absolutely specific. When an animal is injected with a sensitizing dose of some foreign protein the form of anaphylaxis produced is known as "active" anaphylaxis.

Sensitivity is Transferable

If some of the blood serum from a previously sensitized guinea-pig is injected into a normal guinea-pig, the sensitization to that particular protein will be transferred to the second animal, and an exciting dose of the specific protein given immediately to the second animal will cause anaphylactic shock. This is known as "passive" anaphylaxis. Considering the great number of blood transfusions that are being performed, the transference of sensitivity from one animal to another is of considerable clinical importance. Therefore, in addition to the routine examination (Wassermann, blood grouping, et cetera) to which donors for transfusion are subjected, their history, with regard to any possibility of anaphylaxis, should be very carefully gone into and if such a possibility is indicated, tests for protein sensitization should be made.

At this point it may well be emphasized that previous to the administration of diphtheria antitoxin, the patient's history should be carefully gone into, and if there is any evidence of sensitization, a test with horse serum protein should be performed, particularly if the patient is an asthmatic. Neglect to do this may result in severe anaphylactic shock, or even death.

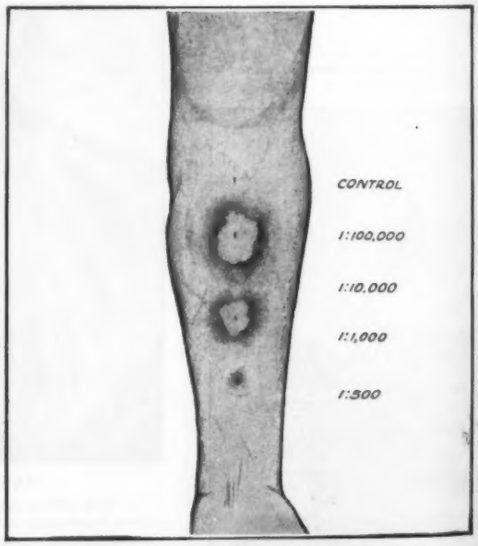
Oscar M. Schloss, in numerous painstaking experiments on children who had idiosyncrasies to various articles of food, brought anaphylaxis out of the field of animal experimentation, into that of practical clinical medicine. He was the first to establish that it was the protein in the food that was the offending element and that all the other constituents were harmless. Secondly, he proved that this idiosyncrasy or hypersensitiveness to some particular food protein was absolutely specific. Thirdly, he demonstrated that the offending protein could be detected by the cutaneous or skin test, which I will explain at greater length in a subsequent paragraph. Sensitization in human beings is known as *allergy*.

Making the Diagnosis

The revolutionary nature of the work just described may be appreciated when we realize that, previous to the advent of protein sensitization, asthma was considered an incurable disease of unknown cause. It can be proved that about one-half of all cases of asthma are due to sensitization to some foreign protein. Asthma cases are therefore grouped into two classes: first, those which are found sensitive to some foreign protein, which are designated as true bronchial or allergic asthma; second, those which are not found sensitive to any foreign protein, which are designated as asthmatic bronchitis. The sensitive asthmatic can usually be completely relieved of all attacks by elimination of the offending protein or proteins from this diet or environment, by specific protein treatment or proper vaccine treatment, or by a combination of these.

It is my opinion, too, that a considerable proportion of the so-called "non-sensitive" or asthmatic bronchitis cases are also due to sensitization to some foreign protein, or perhaps some non-protein substance, and that we have merely failed to detect the offending protein or other substance; and it has been my experience that the majority of them can be relieved by proper vaccine treatment.

Asthma may be due to sensitization to any foreign

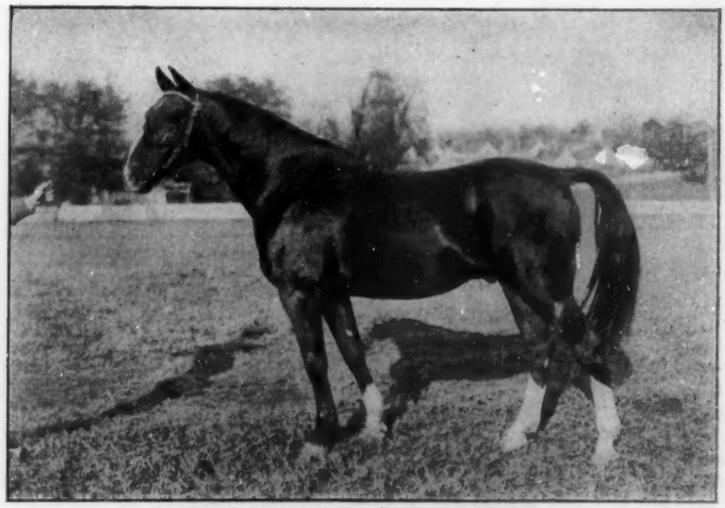


DETERMINING DEGREE OF SENSITIVITY

The reactions to varying dilutions of dog hair protein extract when applied to the author's arm. The strength of the solutions are shown beside the arm

THE HOUSE CAT MAY BE A SOURCE OF DANGER

Dandruff from cats is often found to be the cause of hay-fever and asthma. Cures are then made possible by the removal of the source, often household pets. Then the treatment outlined in this article may be applied by a doctor



EVEN "OLD DOBBIN" IS UNDER SUSPICION

People who have to work around horses, or even those who are in occasional contact with them, often contract asthma or hay-fever from the dandruff of the animal. It is wise for all sufferers from these maladies to keep away from animals

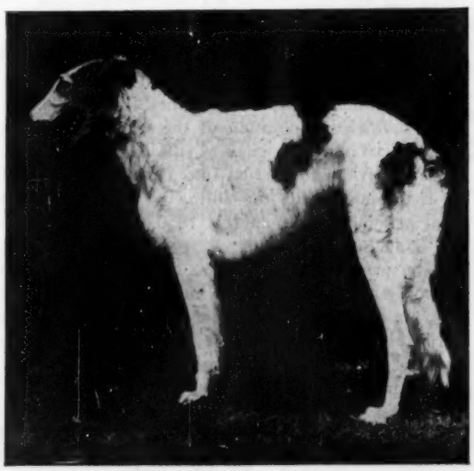
protein with which the patient comes in contact. The offending protein may enter the body by inhalation, ingestion, absorption or infection. Inhalation applies to the proteins of plant pollens, of animal emanations, such as hair, dandruff, feathers, wool, and of miscellaneous inhalants such as orris root, et cetera. Ingestion and absorption apply to food proteins. Absorption may also take place through the membrane which lines the eyelids, the nasal mucous membrane, or, in rare cases, even through the unbroken skin. The word *infection*, however, applies to bacterial proteins. (This is a good place to emphasize the fact that bacteria may act in two ways: first, as a typical infection, with the formation of toxins, or poisons; and second, the patient may be sensitive to the proteins contained in the bodies of the bacteria.)

How Diagnosis Is Made

The diagnosis of the offending protein or proteins, in the individual case, is made by means of the cutaneous test, the technic of which is as follows: both arms of the patient are bared to the shoulder and extended, with the palms up, upon a table adjusted to the proper height. The flexor surfaces of the upper arms and forearms are then cleansed with 50-percent alcohol. A series of linear cuts about one-eighth inch long are made with the tip of a fine scalpel. This is practically a painless procedure. These cuts should be about one and one-half inches apart and should penetrate the outer layer of the skin, but not deep enough to draw blood, other than the merest trace, which is often unavoidable. I usually make eight cuts on each arm, four above and four below the elbow. To each of these scratches, with the exception of the ones just below the elbow on each arm, which should be kept as controls, is applied a small quantity of purified powdered protein of the substances to be tested. To each of these is then added a drop of tenth-normal (0.4 percent) sodium hydroxide in order to dissolve them and to permit rapid absorption. A drop of the solvent is also applied to each of the control cuts. After 30 minutes, the proteins are washed off and the reactions are interpreted.

A positive reaction occurs in from five to 30 minutes, and is indicated by a definite urticarial wheal (or hive) about the site of the cut, at least one-quarter inch in diameter, surrounded by an area of more or less redness. These reactions give no sore arm or allergic shock, even in a very susceptible patient, as the protein may be washed off at any time, thus checking its action. Larger reactions than one-quarter inch are denoted by a series of plus marks, and smaller ones are called doubtful. These doubtful reactions should not be ignored, but should be looked upon as danger signals and repeated at some future time. In some cases a positive reaction is indicated by a large red area, with no wheal formation. With bacterial proteins, there is still a third form of positive reaction, which appears hours later, the site of the inoculation being elevated, hot, inflamed, and slightly painful, having all the appearances of a mild infection. Unless attention is paid to these delayed reactions, a number of positive reactions will be missed. Occasionally, food reactions do not appear until several hours after the tests are made.

To determine the degree of sensitivity of a patient, I make tests with varying dilutions of the offending protein, namely, 1:100,000, 1:10,000, 1:1,000 and 1:500. Treatment is started with the strongest solution which fails to give any skin reaction whatsoever. Asthmatic patients are tested in a routine manner with all food proteins which enter into their daily diet, as well as with the hair or dandruff of such domestic animals as are about the home or place of occupation. Seasonal, or hay asthmatics, should be tested with pollen proteins. Those asthmatics who are susceptible to colds, as well as those who do not react to any other form of proteins should be tested with bacterial proteins. The more proteins that are tried, the more certain one can be of the diagnosis, namely, that all offending proteins have been detected. I use some 280 different proteins, and am continually adding to this supply.



INFECTION FROM DOGS

Both hay-fever and asthma may be contracted from the dog. However both diseases will usually yield to the proper treatment

And now we come to a human ailment perhaps more commonly encountered than is asthma—namely, hay-fever, known, in medical terms, as a typical clinical manifestation of *allergy*. Seasonal hay-fever is nearly always due to sensitization to the proteins of plant pollens, whereas non-seasonal or perennial hay-fever may be due to sensitization to any foreign protein. There is also a form of perennial hay-fever due to a deficiency of calcium (lime) in the system which can be detected by a special blood test and corrected with proper treatment. Summer hay-fever is commonly spoken of as "rose cold," which is a misnomer, as most of these cases are due to sensitization to one or more of the grass pollens. Roses are insect-pollinated, and do not cause symptoms except on intimate exposure, even in sensitive patients. The typical fall hay-fever season is from about the middle of August until the first frost, which coincides with the period of pollination of ragweed, to which pollen practically all of these cases are dominantly sensitive.

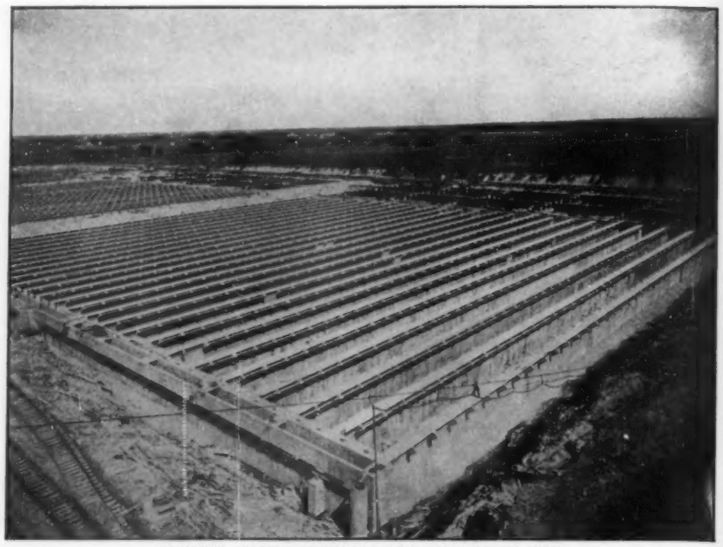
The Best Treatment is Prevention

Undoubtedly the ideal method of treating seasonal hay-fever is pre-seasonal treatment started far enough in advance of the season to get the patient as completely desensitized as possible just before pollination of the particular offending plant or plants. In those cases in which pre-seasonal treatment is incomplete, or in which there has been no pre-seasonal treatment, co-seasonal treatment is well worthy of trial. Pre-seasonal treatment is given at weekly intervals, unless the time is limited, in which case the interval between treatments may be lessened, especially on the smaller doses. Co-seasonal treatment, on the other hand, is preferably given at irregular intervals, depending upon the duration of relief following the individual treatment.

The pollens are grouped biologically or botanically into a number of groups, as follows: *Gramineae*, including the grasses such as timothy, red top, orchard grass, June grass, sweet vernal grass, and the cereal grains such as corn, rye, wheat, and so on; *Compositae*, such as short ragweed, giant ragweed, dahlia, sunflower, golden rod, daisy, aster, and so on. The patient should be tested with the pollens to which he is exposed, and should be treated with the pollen or pollens which give the dominant reactions in any particular group.

A STRETCH OF THE DRAINAGE CANAL

This canal—24.4 feet deep, 28 miles long—extends from the Chicago River to the Des Plaines River and carries Chicago's sewage. The bridge is one of many such structures



NORTH SHORE SEWAGE TREATMENT PLANT

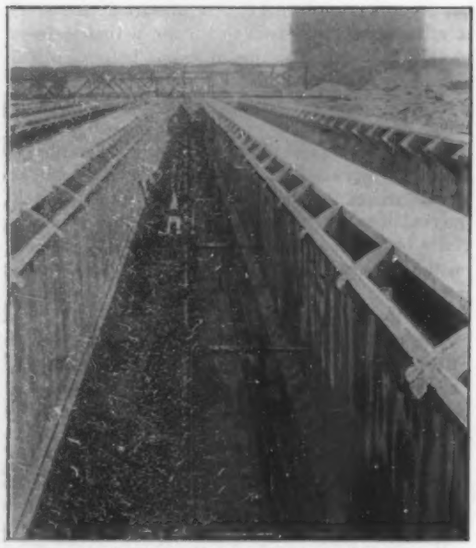
A battery of twenty-four tanks, in which the sewage is aerated by forcing compressed air up through the liquid. This serves to oxidize and render innocuous the remaining impurities

World's Largest Sewage Disposal Problem

Chicago's Great Effort to Purify Sewage and Factory Wastes, Equivalent to That of a Population of Five Million People, by Modern Methods of Tank Treatment

THE Great Lakes are an average of 25 inches below their normal levels. As we showed in our September issue, five inches of this deficit is due to Chicago drawing water from Lake Michigan through its Drainage Canal, and 20 inches is due to shortage of precipitation and a rate of evaporation which lately has been above the average. The canal takes water from Lake Michigan at the rate of 8,500 cubic feet per second to dilute the sewage of Chicago, which is carried by the canal and discharged into the Mississippi Basin.

Chicago is equally concerned with the other Great Lakes cities and the shipping interests over the serious lowering of lake levels, and its municipal authorities are fully alive to the fact that their permit to drain water out of Lake Michigan is not permanent but is revocable at any time by its grantor—the Federal Government. Hence, for several years, the city has been at work investigating, planning and building in the effort to find some other method of disposing of its sewage. The work is in the hands of the Sanitary District of Chicago, which proposes to use the well-proved system of tank treatment by which from 90 to 95 percent of the impurities can be removed from the sewage and the purified water or "effluent" discharged into the Drainage Canal.



ONE OF THE AERATION TANKS

Air is supplied by the pipe at bottom of the tank

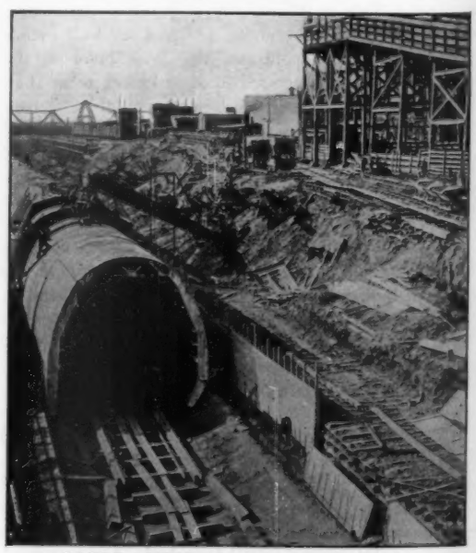
Sewage Disposal in 1850

Ninety years ago, Chicago was a village situated on marshy land at the southwest end of Lake Michigan. Its water supply was obtained from wells. In 1851, municipal operation of the water works was undertaken and sewage was discharged into the Chicago River and carried into Lake Michigan. If we may judge from the following extract from a local paper in the summer of 1850, it was high time that something be done:

"The wonder is not that we have had cholera in our midst for two seasons in succession, and that the common diseases of the country are fatally prevalent during the summer months, but that a worse plague does not take up permanent residence with us. Many of the populous localities are noisome quagmires, the gutters running with filth at which the very swine turn up their noses in supreme disgust. Even some portions of the planked streets, say, for instance, Lake between Clark and La Salle, are scarcely in better sanitary condition than those which are not planked. The gutters at the crossings are clogged up, leaving standing pools of indescribable liquid, there to salute the noses of passers-by. There being no chance to drain them properly, the water accumulates under the planking, into which flows all manner of filth, and during the hot weather of the last few weeks, the whole reeking mass of abominations has steamed up through every opening, and the miasma thus elaborated has been wafted into the neighboring shops and dwellings to poison their inmates."

The Sanitary District has grown with the growth of the city. Within its area of 437.39 square miles is included all of Chicago (199.38 square miles) and some 49 other incorporated cities and villages. At the time of its formation in 1890, the area of the district was 185 square miles and the population was 1,149,738. In the year 1925, the population had risen to 3,350,000 and the area of the Sanitary District was 437.39 square miles. As we said in our last issue, it was the pollution of the lake, with its threat to the inhabitants of Chicago who were drawing their drinking water therefrom, that led to the construction of the Drainage Canal and the reversal of the flow of the Chicago River.

Permission of the Federal Government to open the canal was granted May 9, 1899, with the expressed stipulation that the permit was temporary and revocable at will. On December 5, 1901, the Federal Government restricted the rate of flow through the canal to 4,167 cubic feet per second throughout the 24 hours of each day. Subsequently, various efforts were made by Chicago to secure permission to take a larger amount of water from Lake



LARGE SEWER AT THE STOCKYARDS

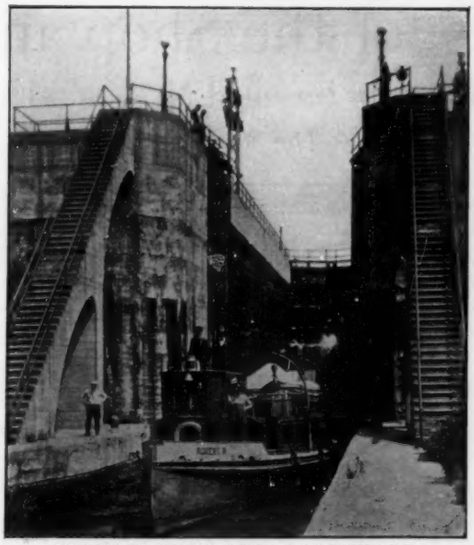
This shows construction of a sewer for waste material

Michigan, culminating in an attempt to secure congressional authorization for a diversion of 10,000 cubic feet per second. The Federal Government has always admitted the necessity for Chicago to take some water from the lake, and the controversy was finally settled on its present basis, by which Chicago is permitted to withdraw an average of 8,500 cubic feet per second, on condition that she provides sewage treatment plants sufficient to handle the sewage of an additional 300,000 people each year for a period of five years.

This permit by the Secretary of War, dated March 3, 1925, reads as follows: "That the Sanitary District of Chicago shall carry out a program of sewage treatment by artificial processes, which will provide the equivalent of the complete (100 percent) treatment of the sewage of a human population of at least 1,200,000 before the expiration of the permit." Another section obligates the Sanitary District to pay its share of the cost of regulating or compensating works to restore the levels or compensate for the lowering of the Great Lakes system, and to post a guarantee of 1,000,000 dollars as evidence of its good faith. This last requirement has been met. The execution of the sewage-treatment program is under the supervision of the United States District Engineer at Chicago. Another and most important clause obligates the city to adopt a program for metering at least 90 percent of its water service. If the city fails to do this, the permit may be revoked without notice.

800,000,000 Gallons of Water a Day

This last clause brings up a most important question in the matter of the use of lake water. It seems that the present average consumption of water in Chicago is enormous—800,000,000 gallons per day, the per capita consumption being about 275 gallons per day. For this purpose Chicago pumps from the lake more water than is supplied to Greater New York, Milwaukee, Cleveland and Newark combined, although the total population served in these four cities is nearly 7,500,000. The Western Society of Engineers, after a study of this subject, stated that metering the water supply of the city would reduce the daily per capita consumption from 275 to about 125 gallons and would result in a saving in the construction of new plants of 88,000,000 dollars in the next 25 years, and a saving in operation costs of 145,000,000 dollars. Reduction of the water consumption, moreover, would bring about a large reduction in the amount of sewage. The engineers of



DRAINAGE CANAL LOCK AT LOCKPORT

At the further end of the Canal are a lock, an electric-hydraulic power plant, and regulating works to control the flow of water from Lake Michigan

the Sanitary District estimate that this decrease would reduce the cost of future projects by 25 percent. Furthermore, the saving in pumping costs, resulting from metering, would finance a complete filtration system for the city. With the adoption of metering, it will be possible to complete the treatment program of the Sanitary District by 1940 instead of by 1945, as is now planned by the trustees. This can be carried out with a water diversion from Lake Michigan of not more than 8,500 cubic feet per second, gradually reducing to 4,400 cubic feet per second or less, as the treatment plants are installed.

The present population of Chicago is 3,426,000, but in addition to treating the sewage due to population, it will be necessary to handle also the industrial wastes from the packing houses and from the food products concerns. These wastes are estimated to be equivalent to the sewage from a population of 1,620,000, so that the total equivalent population in the present year is 5,046,000. As the result of the studies of sewage treatment, six major treatment projects have been outlined, in addition to several small projects for outlying towns and villages. This great work has been under way for several years and the total expenditures on sewage treatment up to January 1, 1923, were 21,254,368 dollars. The construction program from 1923 to 1945 calls for an ultimate expenditure of 116,209,000 dollars.

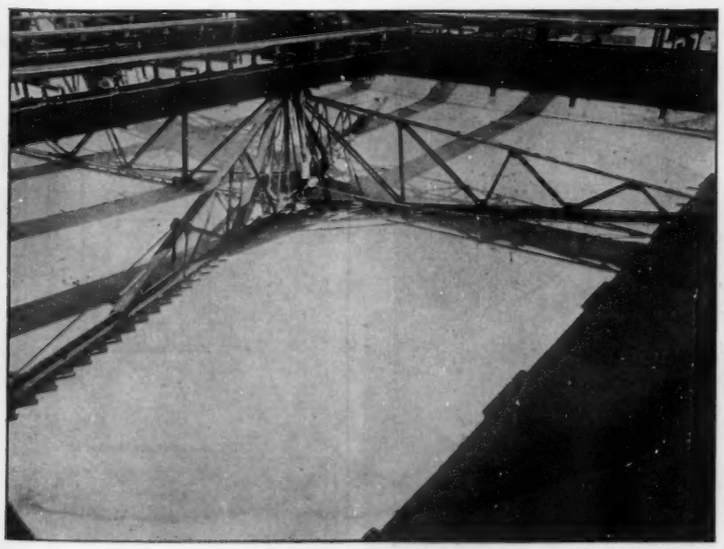
We present several views of the North Side plant which serves a population of 800,000, and on its completion will be the largest "activated sludge" plant in the world. For the construction of the plant, a tract of 180 acres of land was acquired in 1921. The contract for the construction of the North Side aeration and settling tanks was entered into August 9, 1923, to the amount of 5,602,635 dollars. The estimated cost of the completed treatment plant is 13,500,000 dollars. In addition to the treatment works, it has been necessary to construct about 14 miles of sewers ranging in size from four feet to 18 feet in diameter—the total cost of which will be over 10,000,000 dollars.

When the sewage reaches the North Side plant, it is treated in settling and aeration tanks of the kind shown in our illustrations. The settling tanks are large rectangular basins—the floors of which slope gently to the center. Suspended within the tank from an overhead bridge is a vertical shaft, electrically driven, which carries four radial arms, the bottoms of which conform to the slope of the floor. Attached to the bottoms of these arms are a number of inclined vanes or ploughs, which gradually sweep the sludge to the center of the tank, whence it is removed, by pumping, to the sludge beds.

How Impurities Are Rendered Innocuous

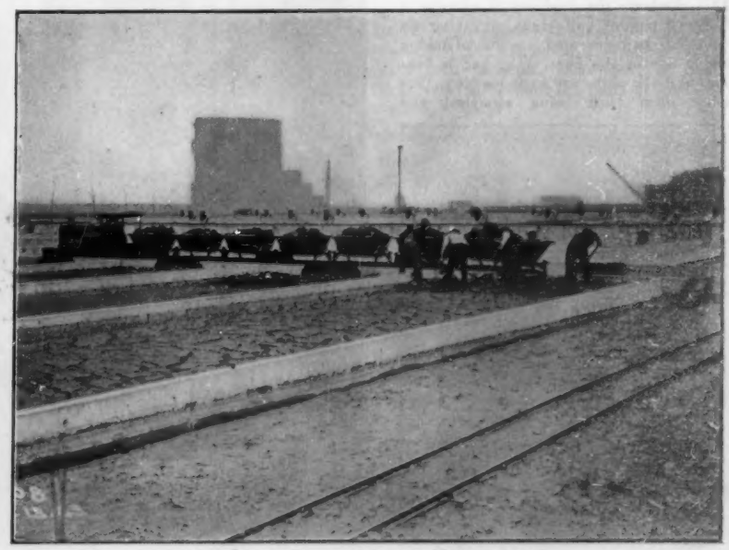
The sewage is also treated in a vast system of aeration tanks of the kind shown in our illustrations. These tanks, which are of concrete, are built in batteries of 24 each. Extending along the bottom of each tank is a large pipe through which compressed air is discharged into the sewage toward one side of the tank. The air rushes up through the liquid material and maintains a constant and violent circulation of the sewage, which is caused to flow up on one side of the tank and down on the other. The sewage is thus thoroughly aerated and the process of oxidation renders innocuous the impurities remaining after the heavy solid matter has been deposited.

One thousand pounds of coal per minute! This is the quantity of fuel that the largest single-unit machine in the world will consume. In our November issue, we will describe this giant of power and present several photographs of it.



ONE OF THE SETTLING TANKS

In these tanks the solids settle out of the sewage. The four rotating arms rake the sludge in to the center, from which it is drawn off by pumping



CALUMET SEWAGE TREATMENT WORKS

The solids which are deposited in the settling tanks are pumped to these sludge beds, from which they are removed and used as fertilizer

Novel Devices for the Shop and the Home

A Department Devoted to Recently Invented Mechanical and Household Appliances

Conducted by Albert A. Hopkins

A vacuum cup holder for keeping the shaving brush in its place

An Efficient Brush Holder

A VACUUM cup holder into which any shaving brush will fit is illustrated here. It prevents the brush from falling into dirty corners or on dusty floors. It will hold it on porcelain, marble, wood, or other material.

A combination bench and portable shaper table. This machine is driven by a one-quarter horsepower motor

Woodworking at the Bench

SOME months ago, we illustrated a very clever little shaper which can be used on the bench or on the actual work, and we now show another member of the family. This machine is driven by a one-quarter horsepower motor and can be used as a bench shaper, portable shaper and small jointer. As a bench shaper, all kinds of small and medium-sized work can be done quickly and without expensive help. As a portable shaper, much work can be done on pieces after assembly as well as on pieces too large to be handled easily. The motor side of the table is provided with two handles for use of the table with motor as a portable shaper. The ability to set the motor shaft at various angles makes possible the use of cutters of smaller diameter which take much less power.

A Mechanical Caddie

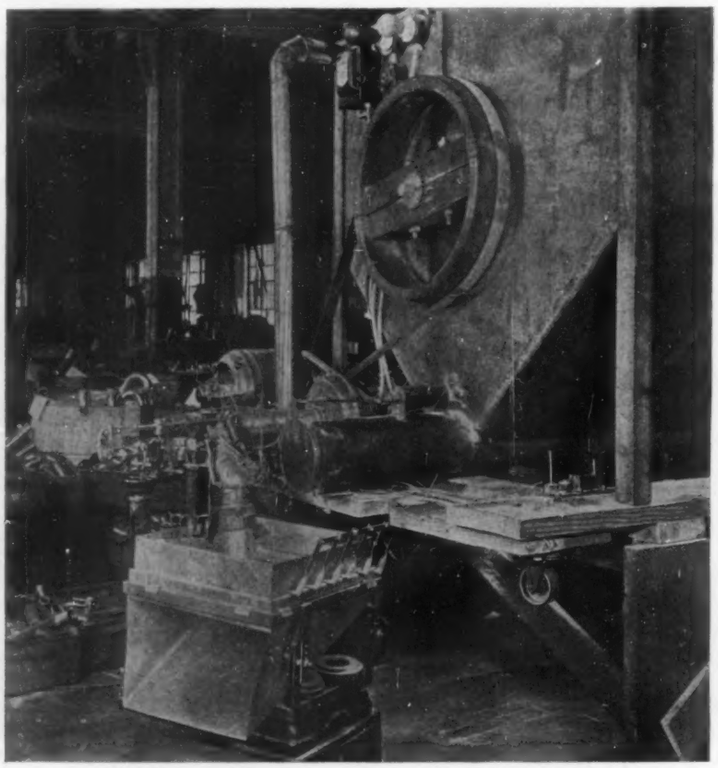
TO eliminate the drudgery of carrying a heavy bag of golf clubs, a carrier on wheels has been invented, capable of taking care of one or two bags. The bag is kept clean and the clubs are kept together, thus saving them from being scratched and marred by knocking together as they do when carried in a caddie bag. The carrier can be wheeled on the greens without marring the grass.

For the caddie-less golfer

Air Suction Comes to the Aid of Scale

A DETROIT inventor has devised a simple and automatic weighing machine in which the excess material is removed by air suction. The illustration shows the construction. The material is fed from the storage hopper into the machine hopper by ratchet feed. This is so connected as to stop feeding when the worm is stopped, thereby controlling the amount fed to the worm. A vibrator serves to disturb materials that cake or pack and cause the same to fall continually on the worm. When the motor is started by throwing the switch, the fan, vibrator and other parts of the mechanism begin to function under control of the weighing device. An electric button is pressed which closes a switch and makes connection with a solenoid.

This solenoid throws a clutch, sliding on a worm shaft, into mesh with another clutch, which is continually turning. At the same time, connection is made with a solenoid which opens the door at the end of the worm. With the worm feed turning and the door opened, the material is forced into the holder on the scale until the amount set to be weighed causes the scale-arm to go up and make contact. This contact closes a circuit and causes another solenoid to throw out the clutch and closes the door tight. The worm is stopped and the door is closed; no more material can be put into the holder on the scale. When the contact on the scale arm is made, a very small solenoid opens the shutter in the air-suction pipe and permits suction of the excess material (one or two ounces) from the holder until the scale arm descends to perfect balance when contact is opened or broken and the shutter closes. The material now weighed is dumped by opening the shutter at the bottom of the holder.



Continuous controlled scale for weighing dry materials

A table toaster which cuts off the heating current automatically

Automatically Controlled Toaster

WE have all seen the automatic toasting machine in restaurants and the sandwich shops which are springing up all over the country. These toasters are too large for home use but now we have a device which can be placed on the dining-room table. This little brother of the restaurant toaster turns out the same brand of golden-brown toast with no burning. You simply drop the bread into the oven slot and depress the two levers. When the toast is done, up it comes and the current is automatically cut off.

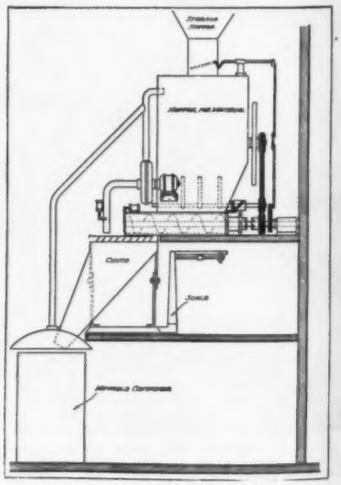
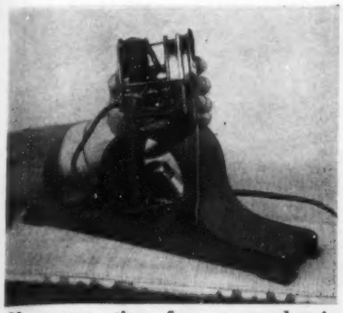


Diagram of the scale mechanism



Observatory time from your electric house-lighting circuit

"Telechron" Clocks

A NEW kind of timepiece has recently been placed on the market commercially, although the principles have been known for several years. This clock has been tested out in the laboratories of a number of universities and gave excellent satisfaction. It is merely necessary to plug into the alternating current and then set the clock accurately. The correct time can be obtained from the power house.

Technically, the Telechron clock—which name means time from a distance—contains a diminutive synchronous motor which has a rotor the size of a ten-cent piece. This rotor floats in oil and makes exactly 3,600 revolutions each minute when it is connected to 60-cycle alternating current. Through suitable gearing, this is reduced to one revolution per hour for the minute hand, and the necessary amount for the hour hand. The 60 cycles is accurately controlled at the power house and checked up twice daily by the Naval Observatory.

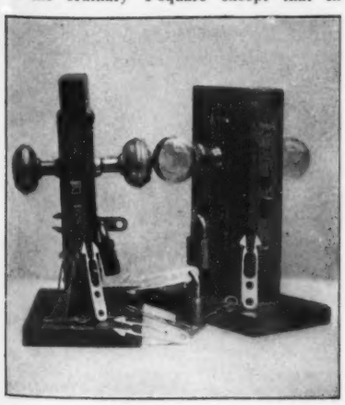
Locking the Lock

THE attachment illustrated is intended to safeguard the none too safe mortise lock by preventing the lock from being picked. The guard is made of spring steel and has two prongs and two holes. The operation is as follows:

First open the padlock and insert the yoke in the hole on the guard; then snap shut and the "Keelock" is ready for use. After the door has been locked in the usual manner, remove the door key and insert the locking dogs into the keyhole, pushing the guard in as far as possible until the locking dogs expand and take a secure grip on the inside of the door plate. The door is now securely double locked. Any attempt to remove the guard by force will only cause the locking dogs to take a more secure grip on the lock. To open the door, unlock the padlock by means of its own key and remove the same from the guard; a slight push will force the guard through the keyhole to the inside of the door.

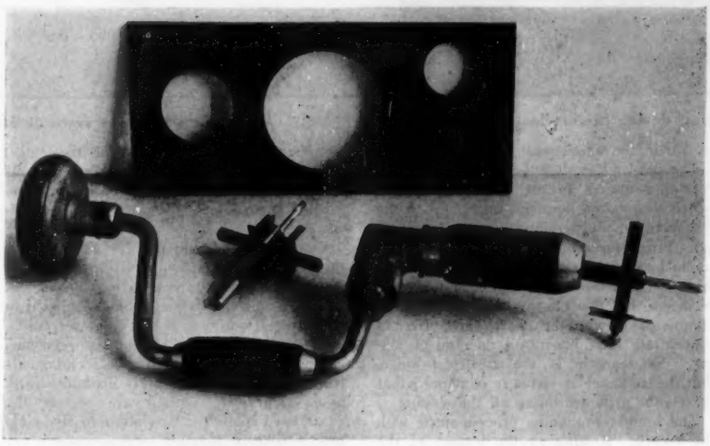
A Third Hand for the Draughtsman

THE magnetic T-square is identical with the ordinary T-square except that in place of an ebony or rubber head, this square is provided with a stainless steel magnetic working head. The drawing board must have, of course, a metal edge, therefore a nickelled steel working edge is provided. The T-square remains in exactly the position it is left. This device comes from England and really gives the draughtsman a reliable third hand.



Guarding the keyhole

A magnetic tee square for draughtsmen



Circle cutting tool that may be used for many materials

An Indoor Seesaw

FOR children who are confined to apartments and have small space for play, there has been invented and placed on the market recently an indoor teeter that is operated by springs. It is called the "Foxy Grandpa Bouncer," and requires only a few feet of floor space. However, it provides much amusement for the children.

An English knife cleaner of unusual design

The Foxy Grandpa Bouncer

A Circle Cutter

THE device illustrated is not limited to cutting circles in bakelite, rubber, fiber, et cetera for radio panels, but can be used to cut veneers, very hard woods and soft metals as well as gaskets, washers, rings and the like from leather, linoleum and sheet packing. The construction is clearly shown in the illustration. A carpenter's brace may be used.

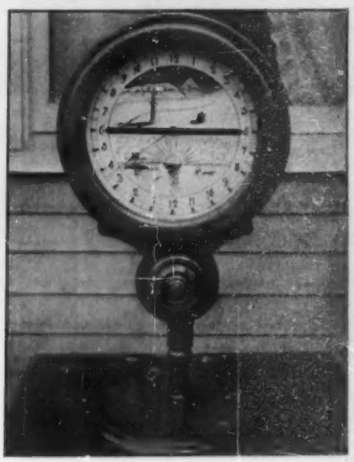
When desired for radio work, the cutting tool is set for the size of the holes desired, then the beading tool is set with the inside edge the same size as the hole cut. This will put a full bead around the hole. To cut thin metal, reverse the cutting edge of the tool bit as the back has a knife-like edge. The tool has been christened "Panwood."

Brighten Up Your Knives

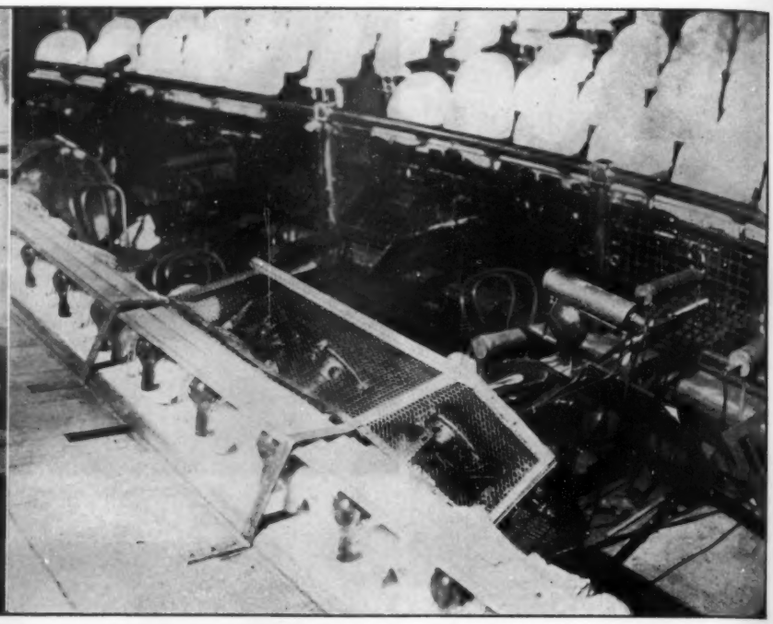
THERE is in New York, a store that is the Mecca of all those who are interested in household inventions, particularly those used in the kitchen. Every summer, one of the owners goes to Europe and brings back quantities of novelties. The knife cleaner illustrated is one of these novelties. This hails from England and seems to be a hard pad of an abrasive substance provided with a convenient handle. It cleans the knives perfectly with a minimum of effort.

A Curious Clock

A VETERAN in a hospital at Augusta, Georgia—Mr. Valter Davis—sends us a photo of a clock he has made in his spare hours, and he probably has many of them. The clock has a single hand and a 24-hour dial. The dial is divided into halves. The upper half represents the 12 hours of night (more or less) and the lower half the 12 hours of day. The painting is appropriate to the periods noted. The works of this clock were made from the parts of an old steam flow meter.



A clock made by a veteran



Courtesy Radio Corporation of America

The super-panatrope transmitting device in duplicate

The super-panatrope reproducing device is also in duplicate

Giving the Chorus Girl a Lift

"GENTLEMEN prefer Blondes" is the name of a well-known play, and probably gentlemen do, and so do theatrical producers, but they like them to sing also. But these exponents of pulchritude are not always singers—more is the pity. Mr. Ziegfeld noticed this and called on science to make up this deficiency of nature. The research laboratories of a great phonograph company and a great radio corporation were appealed to and the engineers produced what is called the "super-panatrope" which has been in use at the Globe Theatre in one of Mr. Ziegfeld's "Revues" wherein, as usual, he glorifies the American girl.

The electrical voice, capable of rendering vocal or instrumental selections throughout the entire range of the musical art, is made possible by a colossal sound-reproducing device known as the super-panatrope. It is, in fact, a larger replica of a similar device now available for home use, and, likewise, operates from electrically cut disks produced by the precise light-ray process. The twists and turns of the record groove are translated into corresponding ripples of an electric current by a magnetic pick-up device. The electrical ripples, in turn, are stepped up or magnified hundreds of thousands of times by an electrical amplifier, and then passed to a cone reproducer which vibrates accordingly and furnishes a faithful rendition of the original musical values recorded in the phonograph company's studio.

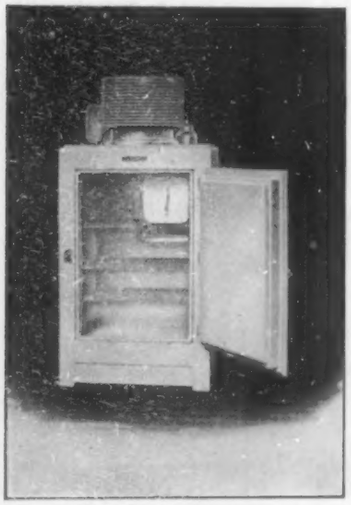
The reader has doubtless often noticed a certain weakness in the finale of a scene where the chorus does not match up to the exigencies of the cast, and in some instances extra musicians are brought into the orchestra to help along the final crescendo. With this electrical voice, the burden of the vocal rendition by the chorus may be entirely eliminated leaving the chorus girls free to concentrate their efforts on dancing or acting. So realistic is the electrical voice, that the audience is virtually convinced that the chorus girls are doing all the singing.

The sound-reproducing process starts with the record. Resting in the groove of the record is a needle, which wobbles in accordance with the serpentine path of the groove and transmits these gyrations to an electromagnetic pick-up, which in turn translates them into corresponding electrical impulses which are amplified hundreds of thousands of times and turned over to a large cone reproducer.

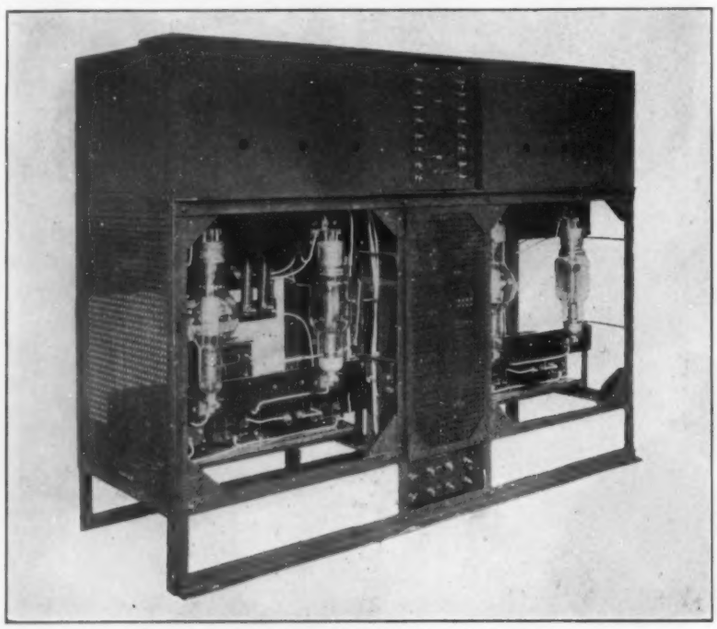
In the theatre installation, the mechanism is placed beneath the stage or in some other convenient place, while the cone reproducer, usually in duplicate, is placed in the theatre, such as in the apron of the stage, facing the musicians. An operator stands by the mechanism, placing the records, replacing them and making the necessary adjustments.

In order to provide positive performance, the equipment is supplied in duplicate throughout. Thus, there are two records, two turn-tables, two magnetic pick-ups, two low-power amplifiers, two high-power amplifiers, two power supplies and two reproducing cones. Any combination of components from either complete set, is instantly available. Duplicate records are set at the exact same point with relation to the pick-ups, revolve in absolute step, and are ready to produce the exact same note in the changeover.

At the pressing of a button, the orchestra leader sets the electrical voice in operation and the leader is in constant touch with the operator, who sets and adjusts the mechanism, by the aid of a microphone and a loudspeaker. The operator himself is also informed of everything that goes on in the orchestra by the same means. Our illustrations show the apparatus below the stage and also the two reproducing cones in front of the footlights. These are cleverly masked. Were it not for the volume control in the hands of the orchestra leader, the giant electrical voice could readily drown out the orchestra and chorus. One other illustration shows the 250-watt vacuum tubes—the equipment being somewhat similar to the better type of broadcasting stations.



The electrical ice man



Rear view of the transmitting device, showing tubes

A Small-sized Electrical Refrigerator

THE small refrigerator illustrated embodies all the characteristics of the larger models—the refrigerating mechanism being contained in one unit. The motor, compressor and all moving parts are hermetically sealed in a compact steel case, containing sufficient refrigerant and lubricating oil to last years of service. The location of the refrigerating mechanism on top of the cabinet makes possible the elimination of all surface valves and pipe connections. The heat generated in compressing the gas rises away from the cabinet instead of enveloping it.

A Coffee Filter for Any Coffee Pot

THE coffee filter illustrated fits any metal coffee pot, percolators included. The water is boiled and poured through, thus making what is called "drip coffee" which is considered the most delicious. The device consists of a bag fastened to a ring and a clip which serves to secure it to the top of the coffee pot.

Brewing coffee easily

The Scientific American Digest

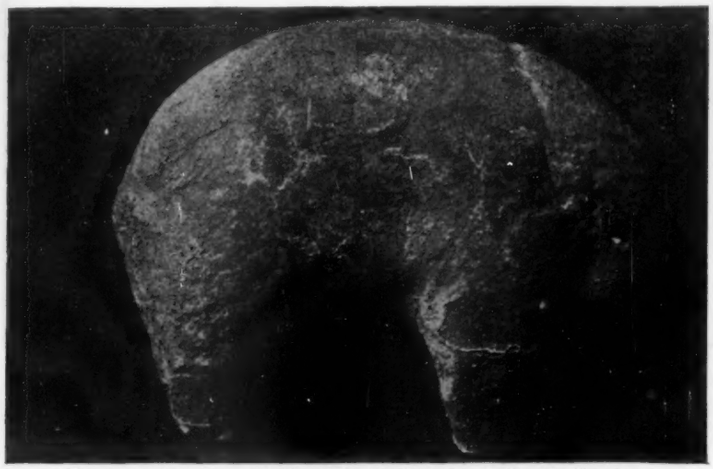
A Review of the Newest Developments in Science, Industry and Engineering

Conducted by Albert G. Ingalls

Mastodon or Mammoth?

How many of our readers can identify the tooth and fragment of a tusk shown in the illustration on page 290? This photograph was submitted to us by a reader in Sweetwater, Texas. He states that the tooth is that of a mastodon. Is he right?

During the Ice Age—which came to a gradual close in the northeastern part of what is now the United States about ten or twenty thousand years ago—both the mammoth and the mastodon ranged over immense and overlapping areas near the great glacial cap, and far to the south of it. Both animals left their remains in large numbers. Their fossils have been found in many places. While these fossils are not exactly commonplace, neither are they rare. For example, 115 mastodon and mammoth remains are listed from various parts of the state of New York, in New York State Museum Bulletin Number 241-242, entitled "The Mastodons, Mammoths and other Pleistocene Mammals of New York State."



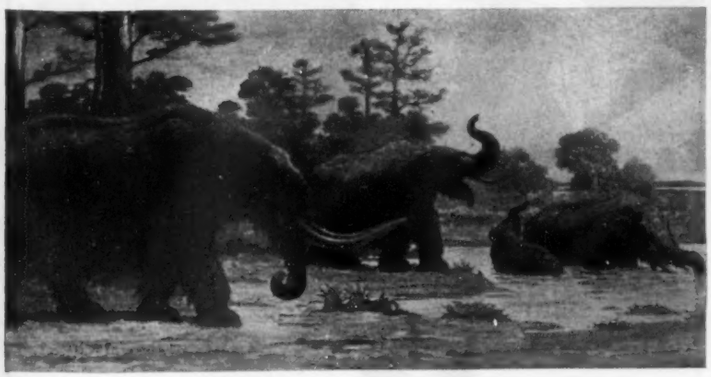
Figurine of a mammoth found in Ice Age clay in Czecho-Slovakia

Concerning the fossils which we have suggested that the reader try his skill in identifying, their discoverer writes, "I enclose a photograph showing a section of mastodon tusk and a big tooth belonging to another mastodon, or to some other animal of sizable proportions found in gravel pits near Sweetwater, Texas. The tusk was taken out intact, but rapidly disintegrated when exposed to the atmosphere. It was about seven feet in length and over a foot in diameter in the thickest portion. The tooth weighs two pounds, twelve ounces. Numerous other relics of pre-historic animals have also been found near Sweetwater."

Both the tooth and tusk are those of a mammoth—not a mastodon. Not only are they those of the largest of the several races of mammoths, but of all that group of elephant-like animals, living and extinct, known as the *Proboscidea*. They are doubtless the remains of Archidiskodon, the great Imperial Mammoth. This giant beast stood from 13½ to 14 feet high. Thus he exceeded by 3½ to 4 feet the height of the ordinary circus elephant.

What then, are the characteristics of these fossils which make their identification so simple? Fortunately, the tooth is preserved, and of all the skeleton, this is the most valuable part for identification purposes. Once one has observed the marked contrast between the molar teeth of the mastodons and the mammoths, one will never confuse the two. While both animals bore strong superficial resemblance to our living elephants and to one another, on comparing them part for part, certain easily distinguishable differences become obvious at once.

The molar tooth of the mammoth is, or was, composed of a series of cusps. Literally, in fact, the word mastodon, means "nipple tooth." The molar of the mammoth is made up of a series of plates on edge, presenting the appearance of a series of low, parallel ridges.



Courtesy of the American Museum of Natural History

The mastodon was a broader, bulkier and more thick-set animal than the mammoth. His legs were especially thick and his head was low

A comparison of the body outlines of the two animals, part for part, reveals pronounced differences, particularly in the shape of the head and the thickness of the legs. The two animals are quite closely related, but the mastodon evolved first. Our living elephants belong with the mammoths.

Professor Henry Fairfield Osborn, President of the American Museum of Natural History, a paleontologist who has been studying the evolutionary relationships of all the proboscideans for many years, has recently reclassified their 290 or more known species, placing them in sixteen "races."

Courtesy of the American Museum of Natural History

Contrast the profile of the mammoth's head with that of the mastodon shown in the lower left-hand illustration on this page

Professor Osborn's work was popularly summarized in the January-February, 1925, issue of *Natural History* (published by the American Museum of Natural History, New York). He has placed the respective races of proboscideans on a sort of "family tree" which is reproduced on page 290.

Perhaps the first thing the readers will notice after a careful study of the peculiarities of each of the outlines, is the large variety of elephant-like forms—in addition to the mastodon, the mammoth and the living elephant—that have existed during the geologic past and have become extinct. In general, the forms at the bottom of the diagram lived in the Eocene Epoch. This is the opening or dawn epoch of the Tertiary Period, or "Age of Mammals." Estimates of absolute geologic time vary, but a conservative estimate for the opening of the Tertiary Period is four million years ago. Compared with the total duration of the evolution of life on earth, even this is only the last 4 percent of it. In the Eocene Epoch, when the ancestors of the elephant and his relatives were in their early evolution, man's ancestor is believed to have been a small ape, but since the majority of the races of proboscideans shown on Prof. Osborn's diagram did not become extinct until the Pleistocene Epoch, or Ice Age, which ended, roughly, 20,000 years ago, some of these beasts, although now extinct, were contemporaneous, at least in continental Europe, with the men of the Old Stone Age.

The proboscideans underwent their early evolution in Africa, but many of their races ultimately reached America by way of a land bridge which existed across the present shallow Behring Straits. Says Prof. Osborn: "An insatiable wanderlust has always possessed the souls of elephants. They have gone to the very ends of the earth and have far surpassed man in adapting their clothing and teeth to all possible conditions of life." Thus 10 of the 16 elephant-like races reached America.

Moeritherium is the most primitive form on the diagram. Its fossils were found in Northeastern Africa. It has no indication of a trunk, but its second incisor teeth are already enlarging. This foreshadows the future tusks of its descendents. It was only a little over two feet high. It lived in the Eocene Epoch.

Courtesy of the American Museum of Natural History

Moeritherium was the oldest, most primitive and smallest of the proboscideans known. The tusks and the trunk were beginning to evolve

Palæomastodon was ancestral to both the ordinary American mastodon and the races of mammoths. It lived early in the Tertiary Period. Its fossils have been found in Egypt. Of the interesting long-jawed forms of mastodons shown on the lower right-

hand part of the diagram, little can be said here. Some of them had four tusks. *Trilophodon*, for example, used its shovel-shaped lower tusks for uprooting plants, and its upper tusks for defense. Its jaw, as long as 6 feet, 7 inches, touched the ground. It spread through India and reached America before the Ice Age—its fossils having been found in the Dakotas, Nebraska and Colorado. Nearly 1,000,000 years ago, it became extinct. *Stegomastodon* fossils have been found in Arizona, Nebraska, Texas and Iowa. *Rhynchotherium* ("beak-jawed") had down-turned upper and lower tusks. It became extinct about 500,000 years ago. It has been found in fossil form in Oregon, Montana, Colorado, California and Mexico.

Returning to the main part of Prof. Osborn's diagram or tree of descent, *Dinotherium* had unique tusks which turned down, and were on the lower jaw. It reached India, but not America, and became extinct about half a million years ago. Note its great comparative height.

Mastodon americanus is the form which is commonly meant in this country by the word "mastodon." It lived well into the Ice Age, ranging from Europe across Asia to Alaska and throughout the United States. It was 7 to 9 feet high and was particularly stocky and robust, with thick leg bones. It was more exclusively a forest-dwelling animal than the mammoths. Its food was twigs, for whose mastication its teeth were well adapted. Its remains have been found in bogs in New York, Indiana, Ohio, Illinois, Michigan and Iowa, where it is said that "every bog contains a mastodon." They have also been found in Florida.

The mastodon wore his hair long—an adaptation to the cold climate in which he lived. Some of this long, coarse hair has been found in a swamp in New York State. It must be remembered that during the Ice Age, even our central states were as close to the ice cap as Labrador is now. The ice covered most of the states mentioned above, but as it melted back, the succeeding generations of mastodons followed it. Many died and were covered and preserved for us to uncover several thousands of years later.

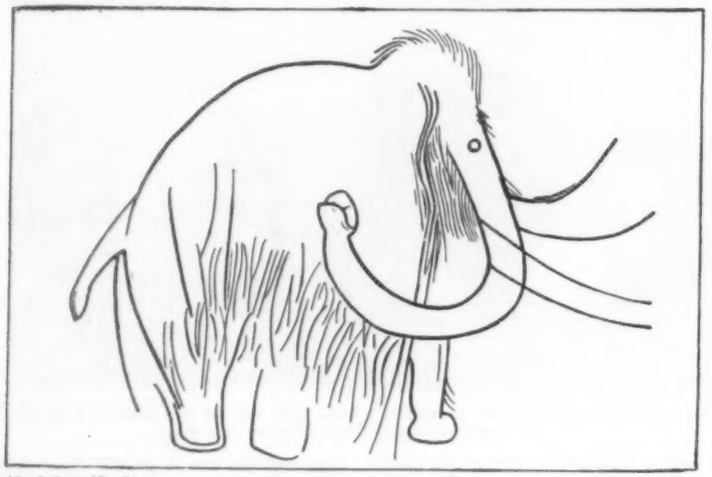
Archidiskodon imperator, popularly called the imperial mammoth, was the greatest of all the proboscideans. His fossils have been found in Nebraska, Kansas, Iowa, Texas, California and Mexico. The Sweetwater, Texas, fossils referred to at the beginning of this sketch belonged to *Archidiskodon*. His height was 13½ to 14 feet. Probably, says Prof. Osborn, he was a tree-and-shrub browser, and when the forests that covered large parts of the west disappeared, due to the melting back of the ice cap to the north, they too disappeared, becoming extinct. Probably he was nearly hairless.

By far, the best-known of the races of proboscideans was the Jeffersonian mammoth (see diagram, *Parelephas jeffersonii*) and the "woolly" mammoth (*Mammonteus primigenius*). The former was large, standing 10½ feet high; the latter was little over 9 feet high and was very shaggy, its hair being 18 inches long, with dense, shorter wool beneath. The remains of both of these races have been found from Northern Europe and Asia to North America. Both races were marked by the extreme acuteness of the apex of the skull and by the strong incurvature of the tusks, which completely crossed each other in old age. (In the illustrations, contrast both head and tusks with the corresponding features of the mastodon.)

So plentiful are the remains of the mammoth that their tusks are used as an article of commerce today—a large part of the ivory we see being fossil ivory, probably ten or more thousand years old. In Siberia, many of their actual carcasses have been found, still frozen in the ice which has preserved them. "No other fossil type has left such remarkably complete data as the Siberian mammoth," says Herbert Lang, Assistant Curator of African Mammals, American Museum of Natural History, writing in a pamphlet entitled, "Problems and Facts about Frozen Siberian Mammoths and their Ivory."

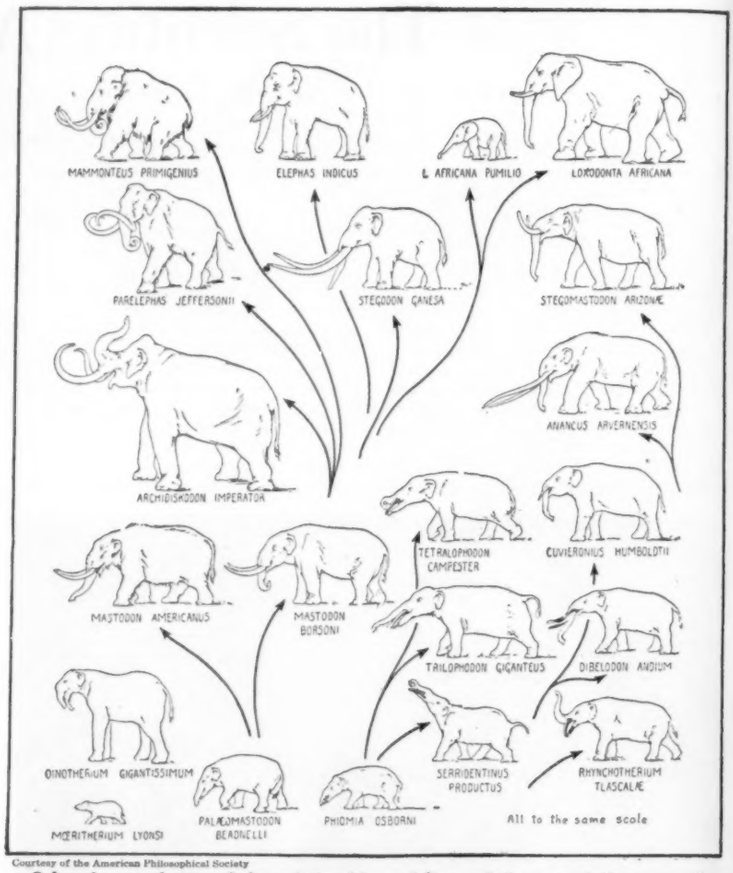
The Cro-Magnon men who dwelt in France after the close of the Ice Age have left us rock etchings of mammoths which they hunted for meat. We also reproduce the photograph of a pre-historic figure of a mammoth. This was found in Czecho-Slovakia, among plentiful remains of charcoal fires and the debris of bones of hundreds of

(*Continued on page 292*)



After Capitan and Breuil

An engraving of the woolly mammoth carved on the wall of a French cave by a Cro-Magnon artist, 20,000 or more years ago

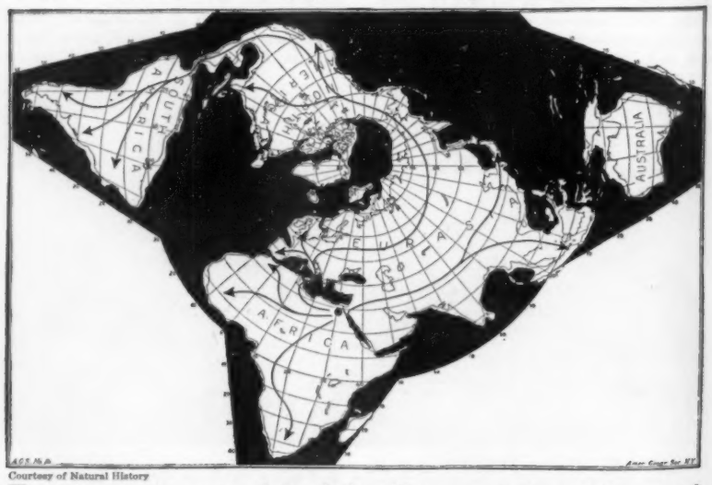


Courtesy of the American Philosophical Society

Osborn's new theory of the relationship and lines of descent of the races of elephant-like animals, living and extinct. Begin at the bottom

Photograph by Minor Shutt

Tooth and tusk of the imperial mammoth, greatest of the elephants. This specimen was discovered near Sweetwater, Texas



Courtesy of Natural History

Theoretic migration routes of the elephant-like mammals from their center of dispersion in Africa, millions of years ago

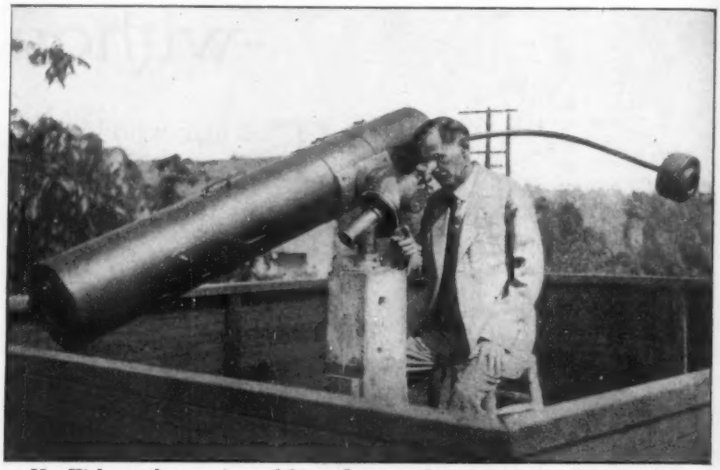
mammoths, killed and eaten 20,000 years ago, by the Old Stone Age hunters.

Gradually the mammoths dwindled in number until they became extinct. Today there are only two races of proboscideans, the African elephant whose true name is "loxodont," and the true elephants of India, Ceylon and Burma.

* * *

Another Amateur's Telescope

ONE of the most interesting reflecting telescopes thus far completed as a result of the telescope campaign which the Scientific American is conducting, is that of F. M. Hicks, 1315 Oakland Avenue, Pasadena, California. Two photographs of this instrument are reproduced on this page.



Mr. Hicks at the eyepiece of his reflecting telescope, which is permanently mounted in an enclosure on the roof of his California home

Mr. Hicks made the entire mounting, but purchased the paraboloidal mirror. This has a diameter of 8½ inches and a focal length of five feet. The outside tube is 10⅝ inches in diameter. The 60-inch focal length is divided as follows: mirror to the 2¾-inch diagonal, 42 inches; diagonal to 1½-inch prism, 11¾ inches; prism to eyepiece, 6¼ inches. Thus it is seen that the mounting is of the stationary eyepiece type described in "Amateur Telescope Making" (Scientific American Publishing Company, 1926) page 31.

In the polar axis, writes Mr. Hicks, there is a Ford roller bearing hub which, with careful balancing of the tube, permits a delicate manipulation of the 90 pounds of tube and counterweight. "Anyone who appreciates the convenience and comfort of a stationary eyepiece," he emphasizes, "will never regret going to the extra expense and work required to build such an instrument."

The declination axis was constructed from a Crane and Company, 2½-inch "T" of cast iron, this being thick enough to permit boring out true and turning in a lathe where necessary. Into this "T," a Shelby tube, one-half inch thick, was inserted. This holds the prism and carries the cast-iron cradle to which the large telescope tube is bolted.

The polar axis was constructed of two pieces of brass tubing brazed together at an angle suitable for this latitude. A Ford roller bearing hub, turned down to suit, was placed in the polar axis tube, where it provides the rotary motion of the polar axis.

* * *

Color Changing Paints Show Temperature Changes

CHAMELEON-LIKE paints that change color when heated, only to return to their original color when cooled again, are the interesting products described by W. S. Andrews, of the General Electric Company's engineering laboratory in Schenectady, New York.

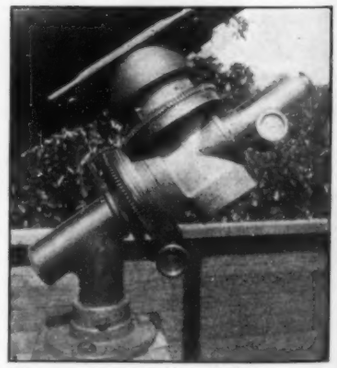
"Such paints are made either of the double iodide of copper and mercury, or the double iodide of silver and mercury," says Mr. Andrews. The former is bright red at ordinary temperatures, but when heated to about 160 degrees, Fahrenheit, changes to a dark chocolate brown which becomes black at boiling temperatures. As soon as it is cooled, it becomes red again. The silver and mercury salt is ordinarily yellow, and becomes a dark orange or brick red at 160 degrees.

Among the uses suggested for these paints by Mr. Andrews are for the casings of bearings and other parts of machinery which are apt to become overheated, with disastrous effects; and for indicating the level of the liquid in a hot water tank. In the latter case, a vertical stripe is painted on the outside of the tank, and the height of the part where the color has changed indicates the water level.—*Science Service.*

A Twelve-inch Reflecting Telescope

MR. JOHN RONEY, 617 West Jefferson Street, Louisville, Kentucky, writes as follows: "In appreciation of your efforts to stimulate an interest in astronomy, I am sending you a picture of my 12-inch reflector, made at home during spare time. I mounted my mirror on two Ford axles. I find this an excellent way of mounting a telescope. It seems, in fact, that the axles were made for this purpose.

"My mirror gives excellent results under good seeing, and magnifications as high as 400 are employed. I polished and figured



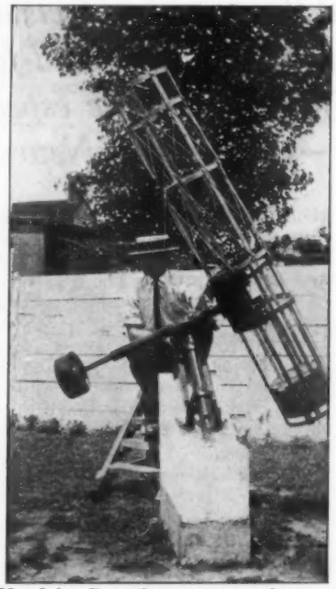
The two axes, setting circles, worms, eyepiece and bottom of the main tube of Mr. Hicks' telescope

nearly nine months before I got the surface of my speculum as I wanted it. The focal length is 78 inches. The disk is one and one half inches thick.

"The tube is built up of soft or machine steel, one inch by one-eighth of an inch in cross-section. This can be bought of any iron dealer in lengths up to 12 feet long. My tube cost just two dollars. These strips are bolted to hoops of the same material with one-quarter inch stove bolts. The hoops are one inch greater in diameter than the mirror. The tube is perfectly rigid, owing to the diagonal stays. My entire instrument was made at home, except for welding a "T" on the declination axis.

(*Continued on page 294*)

"Since boyhood I have been deeply interested in astronomy and wanted a telescope, but was unable to pay the price of a first-class instrument. My first efforts were spent trying to make a four-inch refractor, but later I was willing to compromise with a reflector.



Mr. John Roney's ingenious telescope, with fabricated tube

"Those for whom the starry heavens have never held any fascination, can never know the delight of the observer when he first directs his telescope which he has made with his own hands, upon the sky at night. To me, the beauty and wonders of the sky surpass the beauty of our own planet to the extent that the latter becomes of little interest. I am waiting in wild anticipation for the pictures of other makers and their telescopes."

* * *

What Is a "Beginner"?

APPEARANCES indicate that at about the time of the famous "monkey trial" in Tennessee last year, nearly everyone who had an interest in evolution sat down and wrote a popular book about that subject. This took several weeks, and the publication of these books took several weeks or months more. The result was, that by the time these books were ready for distribution the subject of evolution was comparatively dead, for the largest part of the temporary interest in it had been created over night by the newspapers, and the newspapers know when the psychological time has come to drop a subject from front page scareheads to an inconspicuous stickfull on page seven or nine. Consequently, it has been said that quite a few book publishers were caught "holding the bag." Few of these books, manufactured over night for a sudden demand, were notable, anyway.

However, Professor Graham Kerr of the University of Glasgow has now written an unusually brilliant book on evolution. ("Evolution," The Macmillan Company, New York, 1926.) Instead of making a mere catalog of points in favor of evolution and attempting to meet the stock arguments against it, he has written to make his readers *think*. His style is smooth and eminently readable and his publishers have produced an attractive book.

Professor Kerr is not a mere "armchair" or laboratory student of evolution. He has spent a large part of his life in the tropics studying the ways of animals and plants. In the tropics, he points out, the struggle for existence is most bitter, but comparatively few students of evolution have had the opportunity to witness it there.

In view of the laudatory statements we have made concerning Professor Kerr's book it is necessary to add that in our opinion it is not, as its author states in the very first words of his preface, "a book for the beginner." Professor Kerr uses terms which few beginners would understand, and fails to explain them when first he employs them. In fact, in most cases, he does not explain them at all. Here is a partial list culled from a reading of the book under review. The "beginner" should know not merely their dictionary definition, but their biological significance:

pterodactyl
annelid
arthropod
ontogenetic
parthenogenetic
flagellata
cytoplasm
tetrapod
trypanosome
ungulate
ganoid
notochord
amphisbaenids

"This is a book for the beginner," says Professor Kerr. Evidently, then, if the average intelligent reader can interpret this kind of language he is a beginner. But if he cannot, what is he then? Is this a fair intelligence test?

We disagree with Professor Kerr. His book is admirably suited to the reader who has previously covered a textbook on zoology.

* * *

The New Books

"MATTER, MAN AND MIND" (The Macmillan Company, New York, 1926), by W. F. F. Shearcroft, is a collection of essays on science, having a rather philosophical flavor. In the preface the writer confesses to an insatiable curiosity regarding things scientific, and this has evidently resulted in providing him with a splendid background from which to write a book for other people who have an insatiable curiosity concerning scientific things. Some of the subjects are: geology, the atom, relativity, evolution, life, heredity, chemistry and psychology. Few writers of science can spread over as diverse a territory as this and retain authenticity. This the writer has accomplished. It is not a "fact" book so much as a "thought" book. The style is pleasant and smooth and the type of subjects is aptly suited to the readers of the Scientific American.

Mr. Norvell's reflecting telescope

An Interesting Ten-inch Telescope

MR. G. W. NORVELL, of Covesville, Virginia, has completed a ten-inch reflecting telescope, a photograph of which is reproduced on this page. Mr. Norvell writes: "My ten-inch reflector was built with the help of the book, 'Amateur Telescope Mak-

(*Continued on page 296*)

A Stronger Constitution for Your Car

As casually as you slice bread, an all-powerful shear cuts off billets of glowing steel in the Timken steel mill. Scores of massive operations like this, on such great hulking machines, vividly suggest the scope of Timken production, which includes the largest output of electric furnace steel.

Only Timken experience with 150,000,000 bearings could have evolved such steel. Made into 132,000 Timken Bearings daily, this fine material helps to insure the life and operating economy of so much machinery. For example, 91% of all makes of automobiles and trucks in America are equipped with Timken Bearings.

In motor vehicles Timkens are engineered into transmissions, differentials, pinion and worm drives, rear wheels, front wheels, steering pivots, and fans. These units are wear-proofed not only by Timken-made steel, but also by the higher working capacity of Timken Taper and Timken *POSITIVELY ALIGNED* rolls. This exclusive design permits simple, compact mountings, and defeats friction under all conditions of shock, speed, torque and side-thrust.

—What a lot of fine points you can check about an automobile or motor truck when you know that it is Timken-equipped!

THE TIMKEN ROLLER BEARING CO.
C A N T O N , O H I O

TIMKEN *Tapered Roller* **BEARINGS**

ing,' published by the Scientific American. I had this telescope under way when the book appeared, but the book showed me how to correct my mirror, which I had deeply hyperbolized. After studying this book, and making two or three laps I landed a good correction. I am now enjoying looking at the belts of Jupiter. I can see two large belts, and sometimes three or four lines as well as other markings show up. Saturn's rings look good, also. In other words, this reflector is doing fine work.

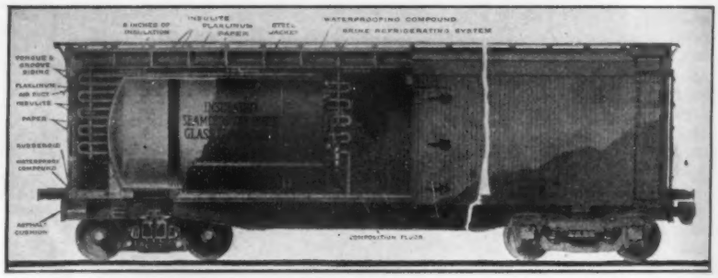
"I had great trouble," Mr. Norvell continues, "for a long time previous to the publication of your book, because I did not then understand the knife-edge test. I was testing just inside the focus all the time, obtaining a shadow with a straight, vertical edge. Now that I understand this test I can tell if there is a surface as small as a pin head wrong with my mirror. I used a disk one and one-half inches thick, and took my time while I was working it."

* * *

Shipping Milk 1,800 Miles to Market

A FINE achievement of unusual note was the transportation of milk, in perfect condition, from point of shipment to point of unloading, over a distance of 1,800 miles, from Marshfield, Wisconsin, to Miami, Florida.

In Florida, the milk problem has been a vitally real one. Cows do not thrive there. Fresh milk is costly—35 cents a quart. The supply is limited.



The insulated car containing a refrigerating system and a large glass-lined tank in which milk was shipped safely 1,800 miles

At Marshfield, Wisconsin, a glass-lined milk tank-car was loaded with tuberculin-tested milk. Dr. Franklin Leiter, City Physician of Marshfield, inspected the content and equipment of the car. It contained six thousand gallons of milk, 40 ten-gallon cans of 40 percent cream. The content was cooled to 35 degrees, the car was locked and sealed, and with the temperature outdoors at 26 degrees, it was sent on its way from Marshfield at 1 P.M., Tuesday, February 16, 1926.

The car reached Miami, Florida, four days and five hours later. Its contents are said to have arrived in perfect condition, the temperature of the milk being 36 degrees, with an outdoor temperature of 92 degrees. The milk was shipped 1,800 miles with an outside temperature change of 66 degrees. Under these conditions the temperature of the contents remained within only one degree of its original.

What the effect of this unusual trial test on the future of milk shipment will be, it is hard to predict. If it proves practicable, and economical, to ship milk over distances as great as 1,800 miles, a great shift in American dairying industry may take place. Almost certain it is that the old-fashioned method of shipping milk in cans, that is, in broken bulk, is inefficient and costly.

* * *

Gold in Sea Water Not Paying Quantity

THERE is gold in sea water, but it will never make anyone rich. Professor Fritz Haber, the German chemist famous for his researches on this subject and also for his contributions to agriculture in making possible the capture of nitrates out of the thin air, warns possible investors against plausible schemes for boiling the wealth of Crœsus out of the ocean. It can not be done, he says.

Gold in exceedingly minute quantities is found everywhere in the oceans of the world, but curiously enough the water and the floating ice near the north pole assay about four times as much as water from the warmer portions of the globe. The average concentration of the precious metal in the 5,000 samples analyzed by Dr. Haber is only about one one-hundredth of a milligram, or three one-millionths of an ounce, to the ton; so that he has characterized an attempt to recover paying quantities of gold from the sea as "a search for a very small and doubtful needle in a very large haystack."—*Science Service.*

* * *

A New Ceramic

THROUGH the introduction of precision methods which start with the raw material itself and follow through to the finished product, there has been evolved a new ceramic.

Isolantite, as the new material is called, goes back to the days of the World War, when the French air service, hard pressed for suitable spark plugs to take the place of former German products, became involved in the major problem of finding an insulating material for spark plug cores. The gruelling conditions of aviation engine service called for something far better than standard spark plugs.

After several years of research, the French technicians were rewarded with a new ceramic possessing many characteristics heretofore associated only with other materials.

Whatever machining or cutting must be done to a piece of this new ceramic must be done prior to firing. Once fired, it is so hard that it defies the hardest steels.

The fine powder of which this material is made is poured into a mold, and the mold is set in a powerful hydraulic press. If an intense pressure is applied, say 25 tons to the square inch, the powder still remains a powder, because the minute particles have failed to adhere. This is because there is nothing "fatty" or moist to bind the particles into a solid mass. However, in the presence of a gas catalyst, which is passed through the loose powder just prior to compression, the powder particles stick together to form a solid mass. Under high pressures applied by hydraulic presses, it is possible to mold pieces and to form round or square rods of uniform density for subsequent machining. Rods as small as 1/16 inch diameter and as large as 10 inches in diameter, may be formed in this manner. Also tubes 1/16 inch up, with pin-holes up to holes almost as large as the external diameter, may be formed by extrusion presses.

The molded rods and blocks are now cut into lengths or slabs of the desired size or thickness, in automatic cutting machines and gang cutters, which cut to size and trim the ends straight and smooth.

The pieces and slabs are next passed through the various machining processes. Thus the round rods may be formed into shells or posts in much the same manner as a piece of brass or steel rod is turned in a lathe. The rod is placed in the chuck of a high-speed lathe and a cutting tool brought in contact with the exposed end. Toier-

(*Continued on page 298*)

Everything that is possible with brass can be duplicated, it is claimed, in isolantite, even to the cutting of accurate threads

ances of hundredths of an inch are met in the ordinary routine work, while precise tolerances of thousands of an inch are met by lapping and grinding as in standard machine practice.

The new ceramic is drilled in the same manner as metal. Standard twist drills are employed. Gang drills are used for drilling grouped holes. It may be tapped for male and female threads, in the standard manner. The threads are clean cut and strong. An iron screw placed in the threading will actually be stripped of its threads before the fired ceramic will give way, according to statements issued.

The raw or soft product is now ready for firing. This converts it from a workable material to a rock-like product. The pieces are placed in carborundum trays and heated to 2700 degrees, Fahrenheit. They are held there for 60 seconds, during which time the heretofore soft material suddenly becomes harder than agate, as strong, it is claimed, as cast iron, and tough.

The new product has found application in radio reception and transmission, where insulation requirements are most critical. Phase difference angle or power factor is the best basis for determining the quality of an insulating material in radio frequency applications, and this material, it is stated, shows a phase difference of but six minutes, or 1/10 degree at most, and 1/100 degree under certain conditions of test. This compares with 26 minutes for hard rubber, and 2.0 and 3.7 degrees, or higher, for other insulating materials that are widely employed in radio. The phase difference represents power loss or dielectric absorption.

The dielectric constant of isolantite is 3.6 at low frequency, and correspondingly less at higher frequencies, as compared with the value of unity for air. The lower the dielectric constant the more desirable is the material for radio purposes.

Still another factor in considering insulating materials for radio applications and in delicate electrical work is resistivity. The volume resistivity of the product under discussion at 50 percent relative humidity is 600,000,000,000,000 ohms per cubic centimeter of volume, and 5,000,000,000,000,000 ohms per square centimeter of surface. It has a break-down resistance of over 30,000 volts per millimeter of thickness, stated to be in excess of any commercial material now available. It retains its insulating and other electrical characteristics at glowing temperatures.

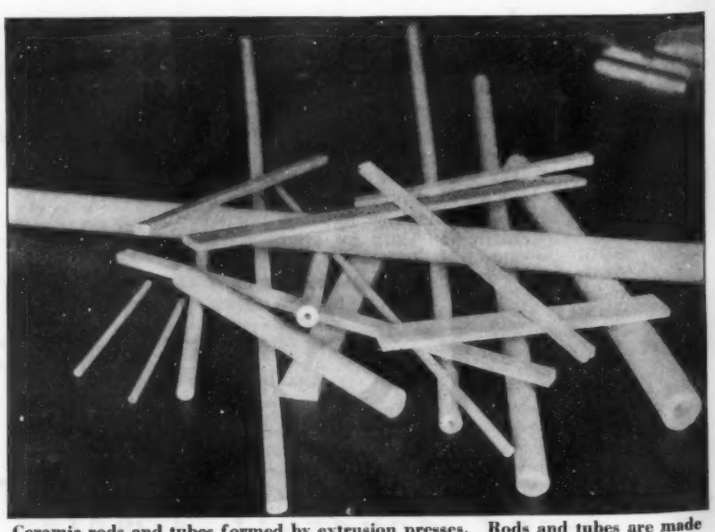
Pieces and tubes, made by the extrusion method, have a wide chemical application, as they are non-porous and will not absorb liquids with which they come in constant contact.

* * *

Skull Operations Fail as Crime Cure

OPERATIONS on the skull to remove the cause of crime are unwarranted medical practice, in the opinion of Dr. Shepherd I. Franz, psychologist in the University of California, and expert in the re-education of the damaged brain.

The supposition that a bony protuberance of the cranium or some malformation due to accident may press on the brain and be the specific cause of wrong-doing is rejected by Dr. Franz and relegated to the limbo of phrenology or like pseudo-science. Surgeons of questionable ethical standards, with pros-



Ceramic rods and tubes formed by extrusion presses. Rods and tubes are made from 1/16 of an inch up to several inches in diameter

pects of a high fee, have been willing to operate on a criminal, the purpose in part being to influence a trial court in the direction of leniency. In some cases of this sort, the patient, profoundly influenced by so serious an operation on himself, has actually been led to believe that the treatment has cured him. Thus purely by suggestion he deserts the criminal life. To this extent only is the cranial operation of any value.

Extended experiments in brain operation have convinced Dr. Franz that the upper brain structure works generally as a whole, and not in specialized departments. Damage or pressure on one spot does not throw any one faculty alone out of commission, nor does any single faculty or sense belong solely to one unique location. Removal or destruction of a small special brain area will seriously upset the entire mental function, but the patient can be re-educated to perform all his duties with other cerebral material. Upon this assumption immorality or crime tendency is likely to be a feature of the entire cerebrum, and not amenable to surgical operation.—*Science Service.*

* * *

Shall We Sterilize Our Mental Defectives?

CONTRARY to a rather widespread belief, even the complete sterilization of all our mental defectives would not be successful in ridding the world of feeble-mindedness for more than a single generation. This is the conclusion reached by *The Lancet*, foremost medical and surgical journal of Great Britain, in an editorial.

If these facts be so, then the much-advocated plan of some social reformers would come virtually to nought, for about seven percent of us are unsuspected "carriers" of feeble-mindedness, in whose children or grandchildren the latent quality would reappear. Thus the work would have to be done all over again.

According to the principles of heredity, first worked out by Mendel, the priest whose noted experiments with sweet peas put the science of genetics on a relatively mathematical basis, the mating of two apparently normal carriers will give one defective child in four, and half the children will again be carriers. There is no known way to ascertain which of us is an unsuspected carrier of feeble-mindedness.

Professor R. C. Plunkett calculated that it would take about 8,000 years to reduce the percentage of feeble-minded in the population from the present three-tenths of one percent to one in one hundred thousand, by segregating or sterilizing those who are themselves actually feeble-minded.

* * *

Why the Oriental Needs Less Food

THAT the Chinese and Japanese can live longer, work longer or starve longer on a low ration of food than the American or European peoples is an ancient belief. Why these Orientals are able to live on so little food has only recently been worked out scientifically. Their basal metabolism, or energy exchange of the body, is lower. They are fundamentally more efficient engines than we are, and their noted ability to live on a scant diet is seen to be not wholly due to their lack of wastefulness or to some special psychological characteristic, such as "natural toughness," which many have ascribed to them.

If one of two otherwise identical steam engines gives a greater relative output of power than the other, we say that its coefficient of efficiency is higher. Evidently, if the tests carried out by Grace MacLeod of the Department of Nutrition, Teacher's College, Columbia University, Elizabeth E. Crofts of the Department of Physiology, Mount Holyoke College and Francis G. Benedict of the Nutrition Laboratory of the Carnegie Institution of Washington, tell us the true state of affairs, the basal metabolism of the Chinese and Japanese is perceptibly lower than that of Occidental peoples.

On several previous occasions, research has

It seemed desirable therefore, say the authors of the report (published in the *Proceedings of the National Academy of Science*), to study the metabolism of a group of Orientals transplanted to an American environment, so that the only variable factor would be that of race. Consequently, these investigators studied the basal metabolism of seven Chinese and two Japanese women.

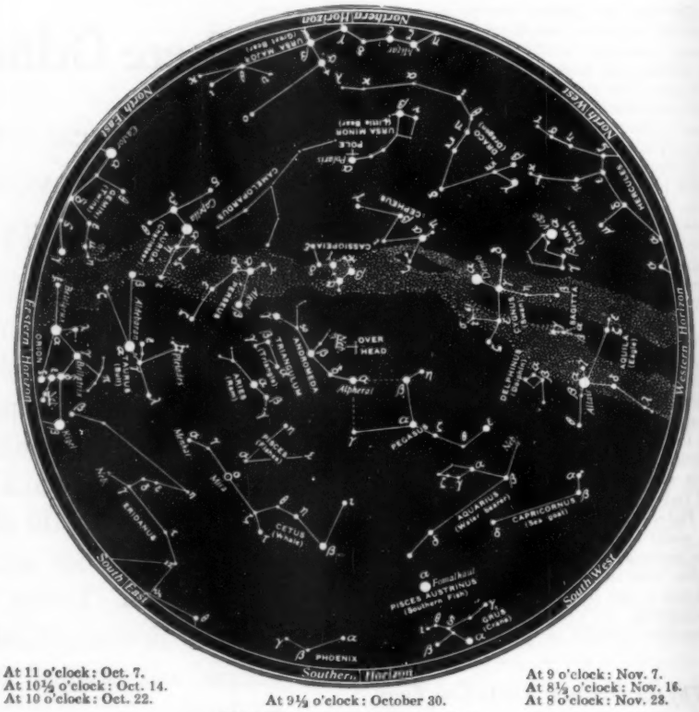
The findings are summarized as follows: The vital capacity was, judged by American standards, very low, that is, 14.3 cubic centimeters per centimeter of height and 1.54 liters per square meter of surface area, as compared with the normal standards for women of not far from 20 cubic centimeters and 2 liters, respectively. The blood pressure of the three subjects measured was normal. The average pulse-rate for the entire group was 60 beats per minute, with a minimum of 54 and a maximum of 64, that is, values that are at the lower, if not indeed slightly below the lower, limits for normal American women.

The most significant findings had to deal with the basal metabolism, which in all cases was below the accepted normal and in most cases strikingly low, the average metabolism being 10.4 percent below the Harris and Benedict prediction standards for women.

Commenting on these findings, the *Journal of the American Medical Association* says: "Has the rush of Western civilization produced a higher metabolic rate? Is the low metabolic rate of the Chinese a physiologic expression of their more philosophic outlook on life?"

The Heavens in October

By Professor Henry Norris Russell, Ph.D.



At 11 o'clock: Oct. 7.
At 10½ o'clock: Oct. 14.
At 10 o'clock: Oct. 22.

At 9½ o'clock: October 30.

At 9 o'clock: Nov. 7.
At 8½ o'clock: Nov. 16.
At 8 o'clock: Nov. 23.

The hours given are in Standard Time.

NIGHT SKY: OCTOBER AND NOVEMBER

The Heavens

ON our star map this month the starry heavens show the great square of Pegasus high in the south. Below it is the great dull region occupied by Aquarius, Cetus and Eridanus. To the west are Cygnus, Lyra and Aquila, in the northwest Draco—due north, the Great Bear low down, then the Little Bear, with Cepheus and Cassiopeia still higher. Andromeda, Perseus and Auriga are in the northeast, and Aries and Taurus in the east, with Orion rising.

The Planets

Mercury is an evening star throughout October but, being south of the sun, is not well placed. At the end of the month he sets about 5:45 P.M. and may be seen low in the twilight. Venus is a morning star, rising about 5:30 A.M. in the middle of the month.

Mars is in Aries, and is becoming very conspicuous as he approaches opposition. On the 1st he rises at 7:40 P.M. while on the 31st he comes into sight at 5:10, and is visible all night. He is as bright as Sirius at the beginning of the month, and much brighter at its close. His approach to the earth appears on the 27th when he is 42,600,000 miles away. Although not quite so near as at this last opposition, he is so much farther north that he is quite as well observable, and important results may be anticipated from the observations of this month and the next.

Jupiter is in Capricornus and comes to the meridian about 8 P.M. in the middle of the month. Saturn is an evening star in Libra, too low to be easily seen. Uranus is in Pisces, observable in the evening, and Neptune in Leo, visible only in the morning hours.

The moon is new at 5 P.M. on the 6th, in her first quarter at 9 A.M. on the 14th, full just after midnight on the 21st and in her last quarter at 6 A.M. on the 28th. She is nearest the earth on the 19th, and farthest away on the 3rd and again on the 31st.

During the month she passes through conjunction with Neptune on the 2nd, Venus on the 5th, Mercury on the 7th, Saturn on the 10th, Jupiter on the 16th, Uranus on the 18th, Mars on the 22nd, and Neptune again on the 30th.

Learning to Use Our Wings

Aircraft are being put to use in peace as well as in war. This department will keep our readers informed of the latest facts about airships and airplanes

Conducted by Alexander Klemin

In charge, Daniel Guggenheim School of Aeronautics, New York University

The *Airster*

PROGRESS in aviation does not always mean novelties or radical departures from standard practice. It is just as important to combine the elements of excellency already known into a harmonious design which can be sold at a moderate price to the public. It is gratifying to know that, besides the usual construction for government purposes, a number of aircraft firms are selling to private operators in quantities. One firm has a production of one airplane a day and announces in typical automobile style that orders must be given several months in advance because sales surpass production!

One of the best of these general utility airplanes is the *Airster* built by the Buhl-Verville Aircraft Company. Equipped with a Wright air-cooled 200 horsepower Whirlwind engine, the *Airster* can land at 45 miles an hour and develop a maximum speed of 120 miles an hour. Its weight empty is 1,550 pounds; fully loaded it weighs 2,550 pounds, and so it has a useful load of 1,000 pounds.

As a passenger airplane, it has comfortable accommodations for two passengers besides the pilot, with an allowance for about 85 pounds of baggage. The young lady in the photograph has easily climbed up a step to the wing, veneer covered to withstand hard usage, and is ready to enter the front cockpit without any great effort. The cockpit is comfortably upholstered and there is a large windshield to protect the occupants from the air blast. The airplane carries enough fuel for 3¼ hours flight at full power, and it can be readily converted into a mail plane with a carrying capacity of some 495 pounds of mail. Incidentally, when the front cockpit is covered in for mail, the maximum speed goes up to 130 miles, sufficient to maintain schedules in the heaviest winds likely to be encountered in the United States.

The front view of the airplane shows how simply the wings are braced, with streamlined metal tubing replacing the bulky wooden struts once customary, and but a few wires to give adequate bracing. The landing gear involves no wires at all, so that adjustment is reduced to a minimum. The shock absorbers are of the telescopic type with the rubber cords enclosed. The metal propeller looks delicate, but is amply strong and is far more efficient than the wooden propellers with their heavy blades. There is a good deal of engine exposed for air-cooling purposes. If hangar space is small, the loosening of a couple of pins allows the wings to be folded back. Well balanced and with plenty of wing area for its load, such an airplane is likely to give the general public something which is almost as useful as a first-class automobile.

Folding Wings

THE Fairchild three-seater cabin monoplane is of the same general utility type as the Buhl-Verville *Airster* and similarly embodies the valuable feature of folding wings. Our photograph shows the wings folded back, reducing the overall width of the airplane from 44 feet to 12½ feet, so that it can be housed in an ordinary garage. While the details of the wing mechanism are not yet available for publication, our imagination will readily show how, by releasing a pin at the point where the front spar of the wing attaches to the fuselage, the wings can be swung about the rear spar connection to the body as a pivot and in a few seconds the plane made to assume its folded proportions. It is not inconceivable that airplanes may soon be seen traveling the public highways, thus arranged, making their way from the garage to the flying field.

Air Sleepers

A RECENT announcement in the *New York Times* states that Fokker, now permanently located in the United States, is building a thirty-five passenger air sleeper to be used in transcontinental service between New York and San Francisco. The airplane is to carry the business man across the continent in something less than thirty hours, flying night and day, and at least three motors are to be employed in the power plant. The fuselage of the airplane is to be built in two sections. The upper section is to be made over into sleeping berths at night, similar to the berths now used by the Pullman Company. The lower section is to be provided with parlor car equipment.

Kalec Forster

A passenger stepping into the cockpit of the *Airster*. It takes but little climbing ability to get into a modern plane

Kaiser Fursfot

Front view of the *Airster*. The modern airplane is "clean," with slender metal struts replacing bulky wooden ones, and with but few wires exposed

Fokker is a designer of such reputation and ability that any such announcement may be treated with respect. At the same time it must be remembered that the provision of sleeper accommodations is a matter of great difficulty, if the dimensions of the fuselage are not to be increased beyond the point where its air resistance will seriously cut down the speed.

"Transport Aviation," by Archibald Black, recently published by the Simmons-Boardman Publishing Company of New York, deals authoritatively with the matter of sleeper accommodation on board passenger air lines. The open cockpit of a military two-seater observation airplane, equipped with a 400 horsepower engine has a width of about 28 inches and a height not exceeding 3 feet. When an airplane of similar power is used to transport some eight passengers in an enclosed cabin, with comfortable seats, a system of ventilation and heating and overhead lighting, it is necessary to provide a width of nearly 4 feet and a height of about 6 feet. Mr. Black has studied in some detail the conversion of such a passenger airplane into a sleeper. He proposes the use of two compartments instead of the one passenger cabin, with toilets between the two. To economize in space and to remove any objections to the use of the space as a passage at times, each of the toilet facilities is to be arranged to swing out of the way into a covered position.

The upper berths are to be raised up to the ceiling when not in use, being carried by cables on spring-balanced rollers. The lower berth is to be permanently located and used as a seat during the day. This plan, however, allows only four passengers to be carried, in spite of the relatively enormous fuselage. It would appear that only in very large airplanes would there be sufficient room for sleepers, because the cubic capacity goes up as the cube of the linear dimensions, while the cross-sectional area and the air resistance go up as the square of the linear dimensions.

Incidentally, readers will find "Transport Aviation" an interesting text dealing with such topics as the scope and coordination of air transport; its general possibilities; costs; and technical problems of operation.

The Boerner Airship

WE are now able to present some hitherto unpublished information regarding the proposed Boerner airship, which has been examined by and has met the approval of competent German authorities.

The outer form of the airship is streamlined longitudinally with a rounded bow and the tail brought to a point, a form which we have learned to associate with airships of all types. However, the cross-section of the airship is almost elliptical, with the underside offering a flat surface to the air. Such a cross-section must inevitably increase the aerodynamic resistance, which is a disadvantage, but it is just as certain that such a cross-section will increase the dynamic effects in flight. When an airship is moving and has its longitudinal axis inclined to the flight path, then dynamic effects intervene—analogous to those which are entirely responsible for the sustaining of an airplane.

In the navigation of an airship this dy-

Herbert Photos

The Fairchild three-seater cabin monoplane showing its wings folded back

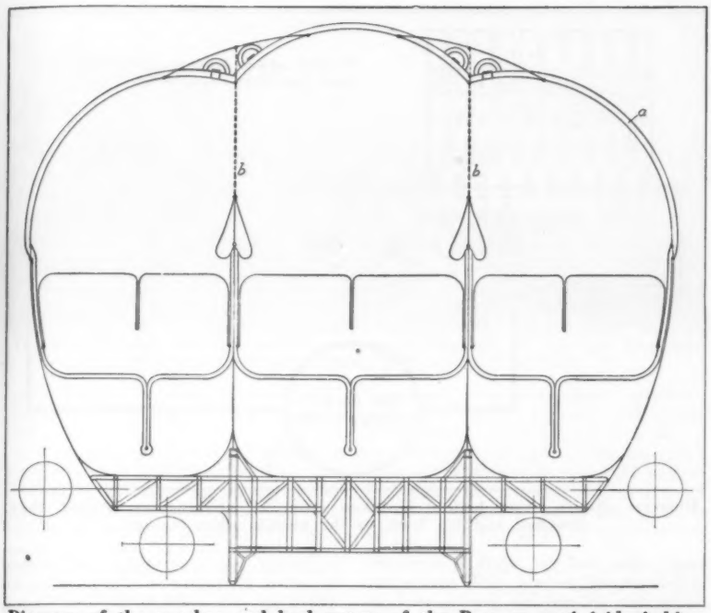


Diagram of the gas bag and keel system of the Boerner semi-rigid airship. The outer cover, a, is double and contains a protecting mantle of nitrogen under pressure. The two parts, b, divide the balloon lengthwise into three compartments and also constitute a flexible suspension permitting expansion of the gas. The ship has a rigid keel

namic effect can be made to counteract, to a certain extent, any loss of equilibrium between the weight of the airship and the buoyancy of the gas. If, for example, the action of the sun's rays causes the gas in the cells to expand, the airship rises. To prevent the rise, the navigator must either allow gas to escape or else he must depress the nose of the airship so that the dynamic force acts downward. If on the other hand, the gas in the cells cools off (as it may do at night or when the airship is sheltered by clouds), and hence contracts, the navigator must resist the tendency to drop by throwing out ballast or by raising the nose of the ship and securing an upward dynamic effect. Valving gas, particularly helium, is expensive. Also, valving and throwing out ballast are both undesirable because either will limit the possibility of further maneuvers. Therefore the possibly increased dynamic power of the Boerner design is advantageous.

The diagram illustrates the gas-bag and keel system. The airship is of the semi-rigid type, with a rigid keel, built up of duralumin girders. These take care of the compressive loads, while the fabric takes care of the tensile loads. With the rigid keel, only a slight degree of excess gas pressure should readily preserve the required form of the airship.

The keel seems well arranged to provide ample cabin and engine space. The outer cover "a" is double and contains a protecting mantle of nitrogen under pressure. The two parts "b" divide the balloon lengthwise into three compartments and also constitute a flexible suspension permitting expansion of the gas. Helium or hydrogen is contained in the upper part of the bags, coal gas in the middle compartments, and air below. When the hydrogen or helium and the coal gas are expanded to their fullest extent, the air in the lower part of the airship is completely displaced. The Boerner airship therefore embodies the equivalent of air ballonets. Air scoops or fans are provided for filling the ballonets when this process is needed in maneuvering.

Hydrogen is readily inflammable, but only when mixed with a certain proportion of air or oxygen. As long as the hydrogen in the gas cells is in a high state of purity it cannot ignite. But if it escapes through the fabric and then encounters an igniting cause, real danger arises. The suggestion has often been made that if a layer of nitrogen separated the inflammable gas from the atmosphere, the danger would be greatly minimized. In the Boerner design such an outer layer of nitrogen under pressure is in the narrow space marked "a" in the diagram. Of course the device involves a certain amount of weight in the extra fabric required, and there is some additional complexity. The inventor also claims, and quite justifiably, some additional protection against fire because of the fact that the engines and passenger compartments are separated from the gas cells by quite a height of intervening air. Experiments have shown the nitrogen to be quite an effective protection against fire, and it also provides a measure of thermal insulation which is valuable, as well as some protection against diffusion, nitrogen being a sluggish, inert gas.

In the lower part of the great central keel, thirty to fifty tons of water are taken in automatically when the ship alights on the water. There again we have an idea which is by no means absolutely novel, yet is worth thinking about. The most plausible form of airship hangar, and one which the Germans have already employed, is a floating one which can be pointed into the wind. If the keel can take on such a large weight of water, there will be no danger of rebound after alighting, nor much danger of sudden lateral movement. The work of the landing crew will be greatly facilitated. There may be some mechanical difficulty in pumping out the water when the ship is to rise, but nevertheless the plan has certain attractions. One in particular is that an ordinary water rudder could be used to steer the airship when water bound.

One of the great difficulties in long range airship navigation is to compensate for the weight of fuel consumed. As fuel is consumed, the airship gets lighter and may rise to uncomfortable heights unless gas is valved freely. A variety of solutions have been offered. Thus in the United States an elaborate system of recovering water from the exhaust gases of the engine to act as compensating ballast has been entirely successful. It is complex however and the large amount of radiator area required means considerable reduction in speed.

British engineers have approached the problem from a different point of view and have succeeded in burning hydrogen mixed with kerosene in their engines; compensation for the decreased weight of the kerosene is therefore followed automatically by the burning of hydrogen and a corresponding decrease in lift. In the Boerner airship the plan is to burn the coal gas (which, as we have seen, is used with hydrogen as the lifting medium) and thus compensate for the consumption of liquid fuel. There is no reason why this should not be as effective as the burning of hydrogen. The draw-

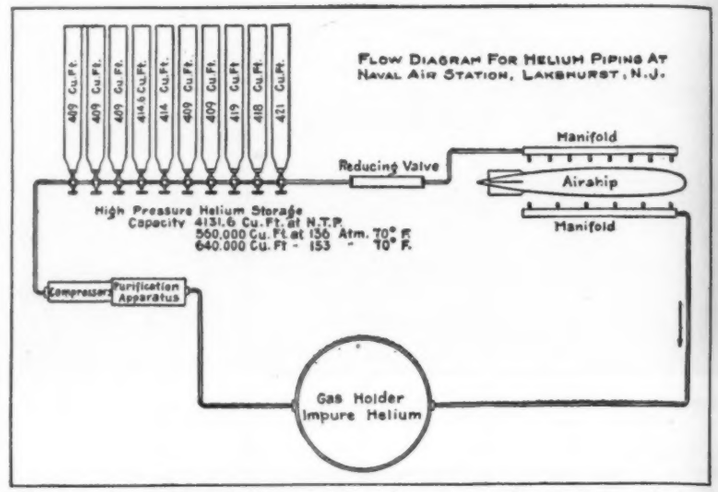


Diagram showing how helium is taken from an airship, stored, and then purified and led back to the airship when wanted

back is that coal gas, which is a mixture of hydrogen and methane, while considerably lighter than air, does not provide nearly as much lift as pure hydrogen. We are inclined to think, therefore, that the use of coal gas as a lifting medium is a disadvantage in the proposed design if compared with a hydrogen airship. There is this to be said for the Boerner design however, that the coal gas could be used as a compensating fuel with helium as the main lifting element.

The design provides for swivelling propellers, and there the engineers are on sound ground, if they can surmount mechanical difficulties. Swivelling propellers in conjunction with the dynamic properties of the hull should render vertical maneuvering very simple.

Whether a semi-rigid design of this type can be realized in the huge sizes of the *Shenandoah* or *Los Angeles* remains to be seen. It offers, however, a possibility of lighter structural weight and contains many valuable ideas.

Storing Hydrogen and Helium

A BOOK on Balloon and Airship Gases, by Chandler and Diehl, recently published by the Ronald Press of New York, contains a wealth of information on a subject which has hitherto only been covered in widely scattered articles and papers. It deals thoroughly with the production processes of hydrogen and helium, with special reference to their use in lighter-than-air craft, and covers many interesting and curious properties of these gases. With permission of the publishers, we cannot resist drawing on this text for a brief description of the little known methods employed for storing the somewhat dangerous hydrogen and the precious helium.

What is a "nurse" balloon? When hydrogen is produced intermittently and in large quantities by the silicon process, it is necessary for military purposes to be able to store it rapidly in a readily transportable form. This is accomplished by using large threeply balloons of capacities up to 35,000 cubic feet somewhat similar in shape to the familiar city gasometers, but with sides like an accordion. From these the hydrogen is drawn to the smaller captive balloons, and hence the term "nurse" balloons.

City gasometers are in the form of an inverted tank or bell dipping in water contained in an overground steel tank. As the gas enters under the water, the bell rises, but the water always forms a perfect seal.

Perhaps our readers have noticed the extraordinary number of rivets which the city gasometer is provided with. The hydrogen gasometer has its rivets set even closer together, owing to the tenuity of the gas. Curiously enough when Ford's engineers set out to design their metal-clad airship, they went to the gasometer for lessons in making riveted seams tight enough to prevent leaks.

The gas bell is convenient and efficient, but where the enormous volumes of gas required for such ships as the *Los Angeles* are to be handled, gas must be stored under pressure. Besides the advantage of conserving space, the high pressure tanks (2,000 pounds per square inch pressure) also have the desirable characteristic of avoiding the solubility of the gas in the water of the bell, and of not needing the steam heat which alone keeps the water from freezing. There is a certain danger of explosion, but this is minimized by testing the high pressure tanks to values far above their working limit.

Perhaps the best example of high pressure tank storage is to be seen at Lakehurst. The ten tanks are only 40 feet in length and 4 feet in diameter, but have a storage capacity of 640,000 cubic feet of gas after it has passed the reducing valve. The diagram shows the very neat manner in which gas passes from the airship to the impure helium holder, then to the purification apparatus, then to the pipes which connect the storage tanks to the reducing valve, and then back again to the airship.

With the aid of the tank cars specially designed for railway transportation of helium, and previously described in our columns, it may be said that the navy has worked out an almost perfect system of storing and delivering our valuable helium.

Miniature Aircraft Fliers

IN Europe in general, and in England in particular, far more attention is given to the training of aircraft mechanics than in the United States. An instance of this is the elaborate system of apprenticeship set up by the British Royal Aircraft factory for the training of expert airplane and airplane-engine mechanics. A group of these boys are shown in our photograph ready to start off their model aircraft at a meet recently held at the Halton airdrome in England. There is no doubt that, apart from the sporting interest of these models, there is a possibility that a great deal can be learned about aerodynamics and airplane construction by their use. But, if this is to be true the models must be built with skill and accuracy.

We have received a small loose-leaf handbook from Frank H. Cheley, Denver, Colorado, entitled "Miniature Aircraft Fliers," which is both excellent and timely. There is more to model construction than at first meets the eye. A flat piece of cardboard is not a wing; light straight-grained wood must be carefully chosen, and cut into spars, ribs, et cetera, with steamed tissue paper as a covering. With the use of cardboard templates it is possible to reproduce the most carefully designed airfoil with accuracy. Tail surfaces may be built in similar fashion to the wings and adjusted at any desired angle to the fuselage by rubber bands. For the fuselage and the motor base, hollow

The Fokker three-engined monoplane now in regular use between Philadelphia and Washington, D. C., for passenger carrying

bamboo forms an ideal structural material, although steel wire and hooks may be substituted.

The handbook gives exact instructions on how to whittle a small block of wood into a propeller, and there can be no greater test of a whittler's skill. Some skill also must be developed in winding flat rubber strands which serve as the source of motive power. It is possible to balance models very accurately to try the effect of various curvatures on the wing, various tail settings et cetera, all of which is most instructive. Speeds of a mile a minute and glides of over a mile have been attained with small models.

A Regular Passenger Service

IN the past few years a number of attempts have been made to establish passenger-carrying air lines. While these were successful from an operating point of view, with but one or two accidents, they were unsuccessful from a financial point of view. Every expedient to attract the traveling public was employed, yet failed to draw patrons in sufficient numbers. It is therefore very satisfactory to learn that a regular passenger service is again in being. This is the Philadelphia Rapid Transit Company's air line between Washington and Philadelphia.

It may be that the holiday spirit and the presence of the Sesquicentennial Exhibition at Philadelphia may have something to do with the influx of flying passengers, but at any rate the service is booked several weeks in advance. The flying distance between Washington and Philadelphia is 125 miles; the flying time is one and a half hours. Even allowing the time required to get out to the flying field by bus, there is some saving over railway time, and there are certainly advantages in coolness and comfort during the warm summer months. Two trips each way are scheduled, and the fare is 15 dollars one way or 25 dollars for the round trip.

The company is a very powerful combination of an old experienced transportation firm, the Philadelphia Rapid Transit Company, and of Fokker ships and Fokker pilots with long European experience in air-line work. The huge three-engined Fokker cabin monoplane is employed, carrying a pilot, a pilot-mechanic and eight passengers. Each passenger is allowed 30 pounds of baggage free, with a 25-cent charge for each pound of excess baggage. Comfortable seats, a lavatory and a baggage compartment are provided.

It is interesting to note that passengers can reserve seats from a chart of the cabin space. Evidently the public is now regarding flying more seriously. The advertising literature of the company carries the following very truthful statement: "Aviation has passed the stage of stunt flying and thrillers and has emerged into the era of commercial development. Airplane safety need no longer be judged by the antics of the loop-the-loop daredevils any more than automobile safety is now judged by the records of race-track drivers."

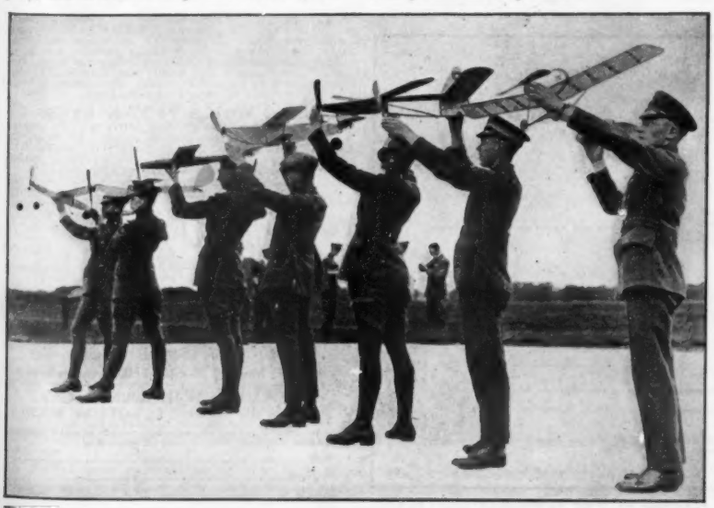
Broadcasting Weather

IN addition to the transcontinental line of the Air Mail Service, there are now in operation some 15 air mail contract lines in the hands of private operators. The problem of giving all such operators adequate weather information service becomes of importance.

The Weather Bureau now has 15 stations in the United States at which upper air observations with pilot balloons are made twice daily. Similar stations are maintained by the Signal Corps and the Bureau of Aeronautics of the Navy Department. It is highly encouraging to note that an Interdepartmental Metereological Committee proposes to coordinate all such stations.

It is proposed to establish further stations, to advance the hours of observation from 6 A.M. to 6 P.M. instead of 8 A.M. to 8 P.M. as previously and to complete the telephone and telegraph weather information service by broadcasting from a number of powerful radio stations.

Until such time as flight can be maintained in all weathers, keeping the aviator posted on the weather in his line of flight is of paramount importance.



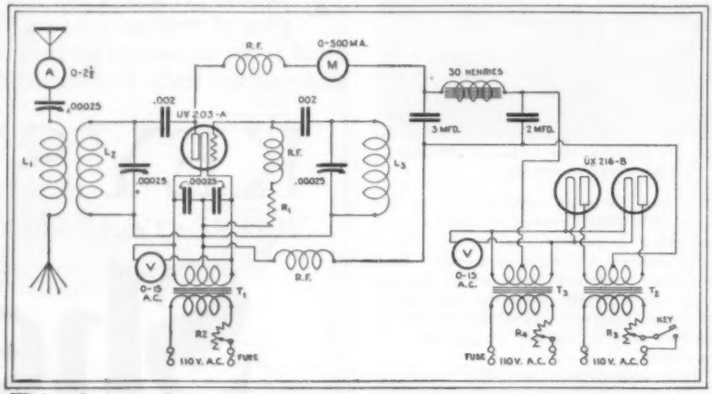
Wide World

Model glider meet held by apprentices of the British Royal Aircraft factory

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Conducted by Orrin E. Dunlap, Jr.



Wiring diagram of the transmitter at station 2NZ. Data on the coils and other parts of the circuit will be found in the columns directly below

Data on Hook-ups of Station 2NZ

THE transmitter used at station 2NZ, New York, the wiring diagram of which is printed at the top of these columns, is known as a "tuned grid-tuned plate" circuit. It is one of the most popular of amateur transmitter installations.

In reference to the diagram, coils L1 and L2 are six inches in diameter and consist of eight turns of edgewise copper ribbon wound clockwise; L3 has the same dimensions except that it is wound counter-clockwise. L3 is placed in slight inductive relation to L2, that is, the coils are from twelve to twenty inches apart. RF represents choke coils, each consisting of 100 turns of No. 28 D. C. C. wire wound on a tube 1¼ inches in diameter. R is a 5,000 ohm lavite resistance. R2, R3 and R4 are each 10 ohms. T1 and T3 are transformers rated at 150 watts with 15-volt secondaries; T2 is a plate transformer rated at 500 watts with a 1,500-volt secondary. V is a voltmeter. The filter condensers are rated at 1,000 volts break-down.

The hook-up of station 2NZ's short-wave receiver is also shown in a diagram. The primary consists of 10 turns of number 26 silk-covered wire for all wavelengths, wound on a form 2½ inches in diameter.

Secondaries are wound on forms three inches in diameter with number 18 bare copper wire, except the secondary for reception on 85 to 210 meters which is wound with number 26 silk-covered wire.

Ticklers are wound with number 28 silk-covered wire on forms three inches in diameter. For waves from one to 30 meters, the secondary has three turns and the tickler, two turns; 25 to 54 meters, secondary six, tickler three; 55 to 110 meters, secondary 15, tickler six; 85 to 210 meters, secondary 30, tickler nine.

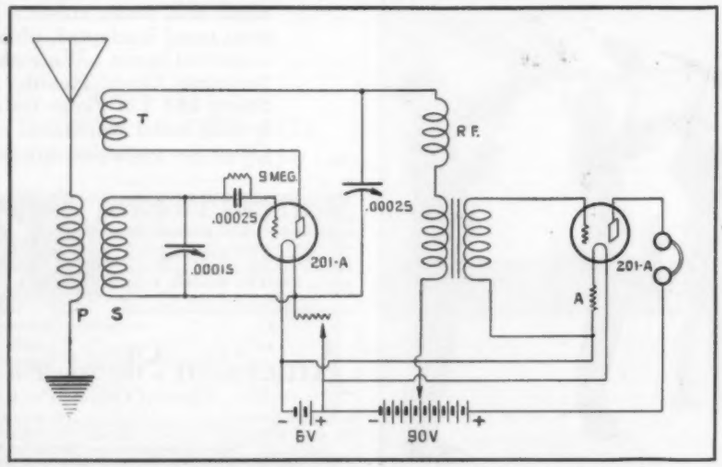
RF is a choke coil, consisting of 100 turns of number 36 silk-covered wire wound on a form one inch in diameter. A is an amperite.

Short-wave Tests at Deal Beach

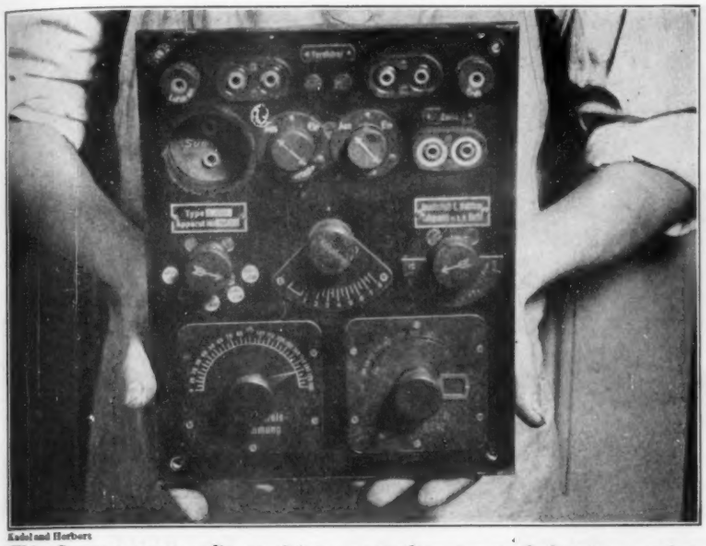
AN experimental station of the Bell Telephone Laboratories at Deal Beach, New Jersey, is investigating various phases of short-wave transmission. Field-strength variations over 24-hour periods are being measured, as are also variations with change of wavelength and distance. Observations are being made regarding night versus day transmission; over-land versus over-water transmission and fading and its effect on intelligibility and quality. Some of the tests are made by means of automatic recorders and others with field-strength measuring sets.

So far the hour-by-hour observations show fairly consistent characteristics and it has been noticed that long waves are attenuated less than short waves over distances up to 100 miles; at longer distances the signal strength of the short waves increases. In most instances, fading is found to be less marked on longer waves. The quality varies somewhat when the carriers and side bands fade simultaneously, but the greatest variation is noticed when the frequencies do not fade at the same time.

It has been found that for distances be-



This is the way in which the short-wave receiver at 2NZ is hooked up. Interchangeable coils, described above, give the set a wide tuning range



Kadel and Herbert

This German army radio receiving set employs a crystal detector, proving this instrument to be reliable for reception under many conditions. The tuner consists of a coupler wound in banked fashion with litzendraht wire, two variable condensers and two special tap-switches. One of the condensers tunes the aerial circuit and the other tunes the secondary

tween a few hundred and 1,000 miles there is little difference between over-land and over-water transmission. Night transmission is superior to that of the day on high wavelengths and day is better than night for transmission on some of the shorter waves. The scope of the tests has been extended to include observation points as far west as Seattle.

The power of the test transmitter at Deal Beach varies from one kilowatt on the shorter waves to four kilowatts on the longer wave channels. The set is usually operated over a wavelength range of 16 to 111 meters.

Radio Helps Ships Avoid Hurricanes

THE United States Navy is developing a system of storm warnings for mariners, which will minimize the danger of ships being caught in hurricanes. Weather bulletins are broadcast daily at 10:30 A.M. and 10:30 P.M. Eastern Standard Time and at noon, by radio stations along the eastern seaboard. The naval station at San Francisco flashes warnings at 1:30 A.M. and 3 P.M., Pacific Standard Time. The plan is to have sailors plot the warnings on weather maps furnished in connection with the service.

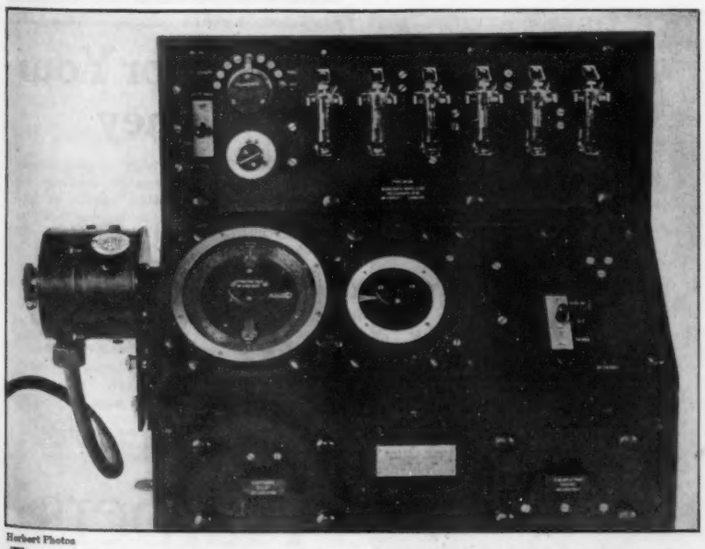
The *U. S. S. Kittery*, in frequent trips between Hampton Roads, Virginia, and West Indian ports, has tested the service and has been able to pass unscathed through storms, by steering out of the center of the hurricane's path. On several occasions, a hurricane was apparent on the *Kittery's* weather map in plenty of time to avoid the brunt of the storm.

The method used by the *Kittery* is that of continuously plotting the radio weather reports, chiefly, barometric pressure. Observations of plotted lines eventually show the rate of speed and direction of travel of the storm areas which are well defined troughs of low barometric pressure. After determining the direction and speed of the areas, the navigators can intelligently decide upon the best course to follow.

Battery Chargers

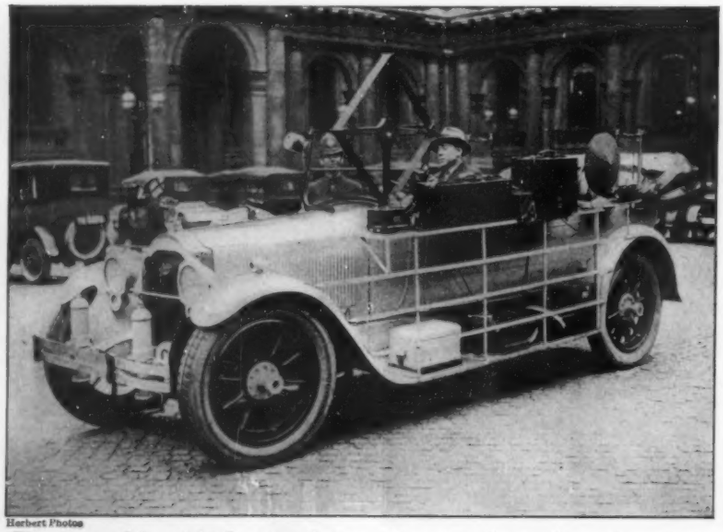
A DEMAND for a combination battery and charging unit has been created by the fact that many radio sets require a storage battery for operation, according to W. C. Brooks of the Hartford Battery Manufacturing Company. Such a device is called a "trickle charger" and is designed to charge the battery at a slow rate at all times when the set is not in operation.

"This idea is not new," said Mr. Brooks at a meeting of the Battery Manufacturers' Association. "In the trickle charger a small six-volt battery is permanently connected to a rectifier, which in turn is provided with



Herbert Photos

The metal box connected to the left of the radio direction-finder is attached to the ship's main gyro-compass. Variations in the latter instrument are communicated to the outer rim of the dial of the goniometer so that the true bearings can be obtained without the need of correcting calculations



Herbert Photos

This automobile might be termed a complete, traveling radio station. It is equipped with a nine-tube receiving set and a 50-watt transmitter. The owner, Capitan Plugge, will drive the car from London to Constantinople and will broadcast his experiences while on the road

a standard plug for light-socket attachment, just as an electric toaster. There are four types of rectifiers used for changing the alternating to direct current after it has been transformed at the proper voltage for charging the battery. All these rectifiers are similar to radio detectors.

"The four types of rectifiers are: first, the bulb or vacuum tube, more familiarly known as Tungar and Rectigon; second, electrolytic, which is divided into alkaline and acid; third, vibrator; fourth, crystal. In the bulb rectifier, a small two-element vacuum tube is employed and this is perhaps the most popular rectifier thus far.

"The electrolytic rectifier was first developed and most commonly used in the alkaline type, being formed of a single cell having aluminum and lead electrodes and a borax solution. The second type of electrolytic rectifier, which is a new development, uses an acid electrolyte and some rare metal or alloy electrode and a lead electrode. The most familiar combination is the tantalum rectifier. This has been successfully used and is a desirable arrangement because it has approximately the same electrolyte as the battery. The only difficulty with this type is a tendency to go dry in continuous operation, especially in a warm place, but if it is properly proportioned it will need water no more than a battery.

"The third division of rectifiers, that of the vibrating type, may well be dismissed from consideration, because it depends upon a vibrating armature, which produces sparks creating interference for the set.

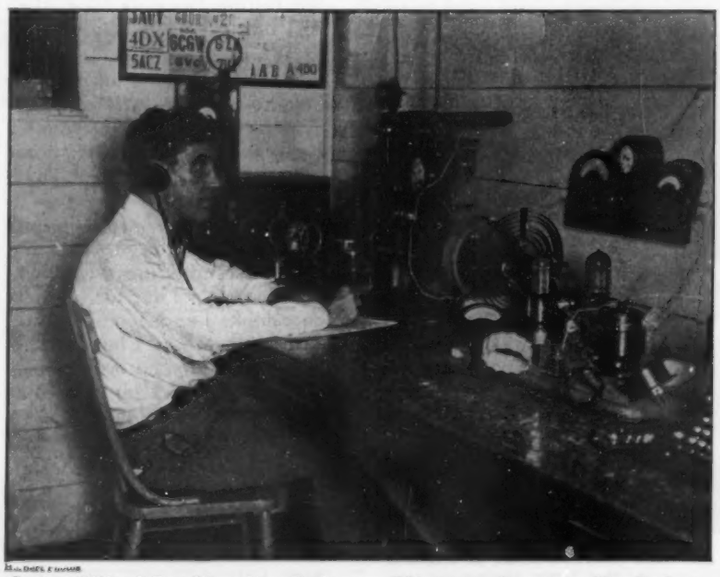
"A new type of rectifier for this service, which will probably have increasing application in the future, is the dry crystal. Since the trickle charger will require only a small amount of current it seems easily possible to multiply the number of detectors until they have sufficient current-carrying capacity to operate a trickle charger. There is considerable work being done on this charger at present, and undoubtedly in the near future some of these devices will be on the market."

Radio Pictures a Routine Business

TRANSMISSION of pictures across the Atlantic is developing into a routine business. The London end of the circuit is in the hands of the Marconi Wireless Telegraph Company, Ltd., and the New York end is handled by the Radio Corporation of America.

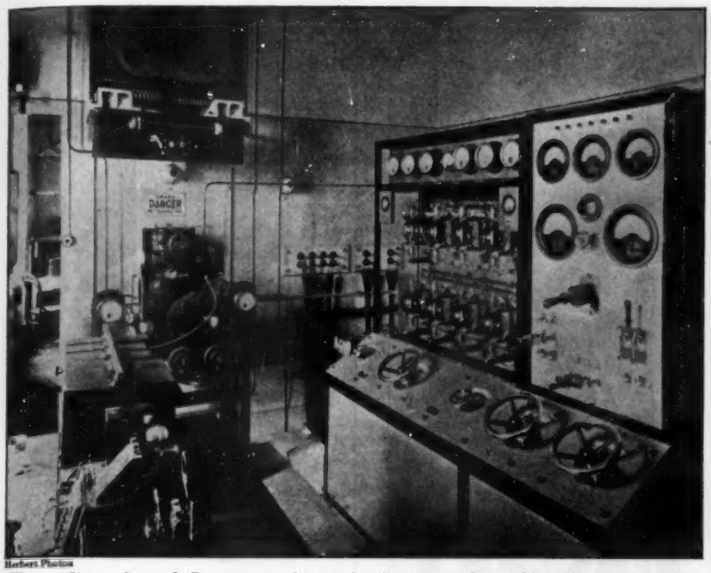
Photographs received in New York but destined for another city are forwarded by special delivery or air mail. Pictures received in London are relayed to the continent by airplanes.

The maximum dimensions of a picture which can be flashed across the sea is 4¼ by 11½ inches. The size is determined and limited by the width of the glass cylinder



Underwood & Underwood

Station 2DS of Brooklyn, New York, uses 100 watts of power. Signals from this station were heard by the MacMillan expedition when they were far into arctic territory. The transmitter operates on the 40-meter band



Herbert Photos

The radio voice of Lausanne, Switzerland, is rated at 1½ kilowatts. The transmitter was built by the Marconi Company and is known as the type Q

and its circumference, around which the picture is placed for transmission. Pictures or written matter exceeding these dimensions can be divided into strips not exceeding 4¼ on one side and 11½ on the other.

The rate is four dollars per linear quarter inch or 16 dollars per inch with a minimum price of 50 dollars. A picture 4¼ by 5 inches would cost 80 dollars. An additional quarter of an inch is necessary for the transmission of an address and it is charged for at the regular rate.

Photoradiograms may be filed in the form of photographs, prints, negatives, positive films, line drawings, handwriting or printed matter. The printed matter should be set in type not less than 10-point in size and a larger type is preferable.

Radio Legislation

THERE will be no new radio laws enacted in the United States until Congress meets in December. The Senate has passed the Dill bill and the White bill passed the House. Both bills pertain to radio control and conferees are now at work ironing out the differences in the two bills. It is expected that the conferees will make a report early in December when Congress reconvenes.

The White bill provides for radio control through a bureau under the direction of Secretary of Commerce Hoover and a part-time advisory commission. The Dill bill would take control of radio out of the hands of Secretary Hoover and give it to an independent commission of five members, one to be appointed from each of five regional zones, into which the country would be divided. The salary stipulated for the commissioners is $10,000 a year.

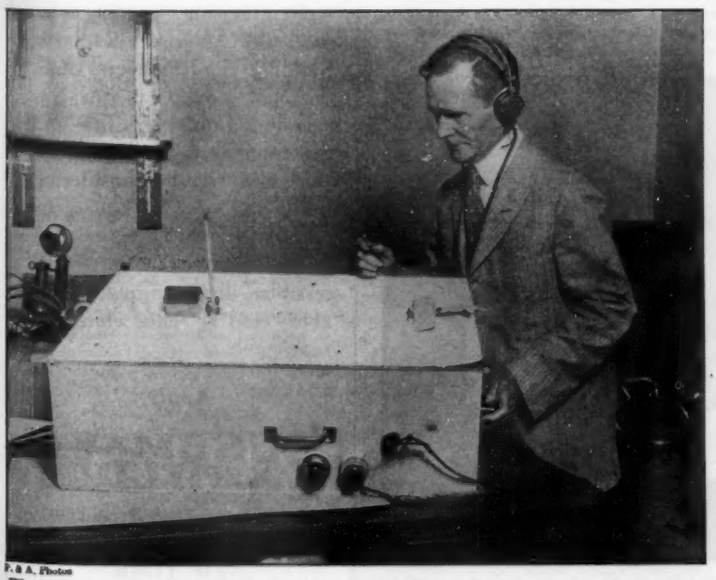
President Coolidge has been reported as endorsing the White bill which leaves the control of radio in the hands of Secretary Hoover.

Musical Appreciation

BROADCAST programs designed to stimulate greater appreciation of music will be radiated by KDKA, Pittsburgh, beginning in October and continuing until May. The series has been arranged by the station's musical director with the cooperation of the National Federation of Music Clubs and the Pittsburgh Musical Institute.

Engineering Council to Study Radio

THE American Engineering Council is seeking a "public service solution" of the broadcasting problem, according to the President of the Council, Dean D. S. Kimball of Cornell University. An investigating committee will be named by the Council to



P. & A. Photos

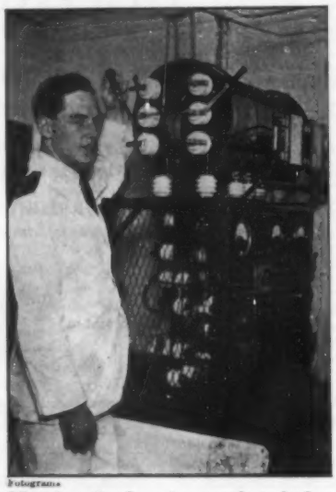
This photograph shows J. P. Buckley, draftsman and designer in the Bureau of Standards' Laboratory, with a model of the directive radio beacon which is now perfected and which is designed to guide airplanes in flight. The device will undoubtedly be a great aid to night and cross-country flying

examine the entire situation, which, he said, threatens to create "a radio chaos of inestimable complexity," affecting 20,000,000 listeners.

"Many of the problems are fundamentally of an engineering nature," said Dean Kimball, "and will be studied by a special committee in an unbiased, broadminded, comprehensive manner, so that accurate conclusions may be generally available in convincing form."

Alkali Vapor Used as Tube Filler

A NEW type of radio tube known as the CX-300-A using an alkali vapor as a filler has been placed on the market by E. T. Cunningham, Inc. It is designed so that, in order to use the tube in the standard broadcast receiver, no change in wiring or circuit arrangement is necessary, although a slight improvement will be noticed if the grid return is connected to the negative filament. A combination of high sensitivity and smooth regenerative action makes this tube useful in short-wave receivers where radio-frequency amplification is less effective.



Fotogram

Wavelength changing on board the *S. S. Scythia* is a simple matter. It is only necessary to manipulate one of the two switches shown above

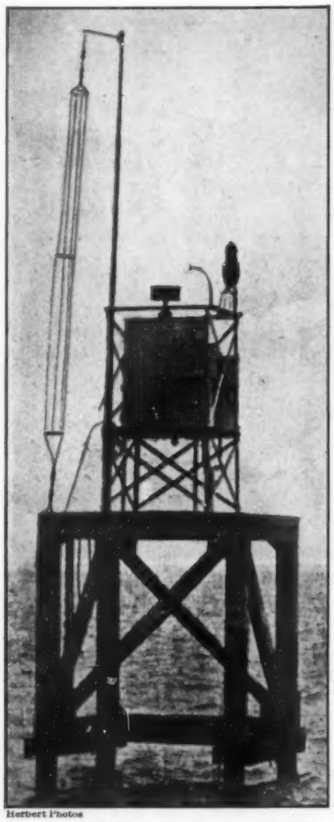
Code Still Lives

THE Morse code still exists because it is the most economical means of getting a given amount of words from one point to another in the shortest time with the least power over the greatest distance and through the greatest amount of interference.

Static Useful

STATIC is good for something, according to the United States Forest Service. It has been found that, by measuring the intensity of the atmospheric strays, it is possible to forecast periods of low humidity or fire hazard by several hours, during which time the forest fire-fighting forces may prepare for action.

Static intensity is also a good indication that thunderstorms are approaching, even 24 hours in advance of any visual indications.



Herbert Photos

Unattended fog signals, operated by radio are now installed on a sandbank in mid-channel at the entrance to the Firth of Clyde, Scotland and at Whitefarland Point

Direction Finder for Coast Guard

A NEW direction finder has been developed by the Bureau of Standards for the Coast Guard for installation on a fleet of patrol boats. The direction-finder coil consists of four turns of ignition cable wound on a 20-inch frame, installed above the pilot house and rotated from below. A coupling unit has been designed so that the loop can be attached to the ship's receiver.

Harris & Ewing

Engineers say that fading is the worst obstacle to broadcast reception. This picture shows T. Parkinson of the Bureau of Standards operating a portable fading recorder which makes a graph on a strip of paper as the signals wax and wane and so enables engineers to study various phases

A New Public Danger?

Ever since the advent of the automobile to our public highways, the difficulties of the pedestrian in attempting to preserve his life have been the source of both serious and humorous comment on various occasions. Now we have the airplane in rather general use and it brings its own peculiar troubles. Although "pop" bottles and other objects that mark the automobile tourist can be dropped from the car while traveling, with no danger than perhaps to the tires of some other vehicle, it does not seem safe to follow the same procedure from an airplane, as is evidenced by the following clipping from the *New York World*, sent to us by one of our readers. Possibly this occurrence will bring forth a flock of protective devices to be worn by pedestrians, automobiles, horses, cats, cows, et cetera, in order to prevent future happenings of a like nature.

While riding in an automobile with her family, Mrs. A. D. Montayne, of Cincinnati, suffered a severe gash in the top of her head from a soft drink bottle which crashed through the top of the car. The bottle evidently had been dropped from an airplane overhead.

Sensational

Recently Sir Jagadis Chunder Bose, Director of the Bose Research Institute, Calcutta, India, published a book entitled, "The Nervous Mechanism of Plants." (Longmans, Green and Company, New York.) This work, according to the publishers, "establishes the fact of the existence of a nervous system in plants." Other scientists claim that the fact of the existence of a nervous system in plants was known long ago, and was not established by the noted Hindoo savant. "If any physiologist has had the foolish notion that plants are less sensitive than animals," writes one of them in a personal letter to the editor, "I can only say that he hasn't worked in a first-class laboratory."

Recently so much sensational publicity has been accorded to other "discoveries" of the celebrated Hindoo by the newspapers and by certain magazines—notably the *New York Times Book Review*—that Dr. D. T. MacDougal, Director of the Laboratories for Plant Physiology of the Carnegie Institution and Corresponding Editor of the Scientific American, has taken rigorous issue with many of these claims. The following is a communication from Dr. MacDougal, whose eminent standing among scientists is well known:

The scientist is continually called upon to give credence to the improbable and to accept the apparently impossible. The researcher, however, cannot stand receptive to sift and weigh every unsupported assertion and flying rumor retailed in the market place. Nor, if he does the more important work which falls to him, can he spend much time on the purple fringe of bizarre contributions to his subject.

The naive review of Mr. Van Buren Thorne of the work of the Indian scientist Bose calls for some attention, because the wide publicity resulting from its appearance in the *Times Book Review* of June 20 may mislead many persons of even less discrimination than the author of the review, who assumes the pose of discoverer of unappreciated genius.

Bose has given many lectures in America, some of them self-suggested or volunteered, and has encountered the well-known American toleration to speakers from beyond any of the Seven Seas. His oral efforts, supplemented by a steady flow of books (a futile row of them is at my elbow) and by perfervid outpourings of imaginative conceptions and self-praise in Calcutta newspapers, widely cabled abroad, have given his work as wide a publicity as the theories of Einstein have received. Einstein's conceptions seem to endure publicity, but those of Bose do not.

Few of Bose's claims on other subjects stand the scrutiny which would give them place in text-books and compendiums. Mr. Thorne seems to have read much *of* this material but to have seen very little that has been written *about* it, and he attributes a similar non-judicial attitude to the working scientists when he says of Bose, ". . . his critics have not read this book." The notices and comments on Bose's work by critics in England, Germany and America to whom some degree of competence must be attributed have apparently not reached Mr. Thorne. Practically all of these state outright that the results prized so highly "await confirmation," a kindly condemnation suggesting that the alleged discoveries should be supported by some actual proof by the author. The reviewer in clumsy adoration says:

"In the course of these investigations he discovered and proves that plants are sensitive to minute burns and transmit impulses, possibly of distress, therefrom: to the effect of acids, electric shock and to the narcotic action of poisons. He also found that plants become fatigued, recovering after rest."

These conclusions, in so far consonant with fact, were well established by researches made prior to Bose by as much as fifty or a hundred years. Toward their perfection Bose has contributed no serious addition.

As to methods, the gradual piercing of the complex and delicate tissues of a plant stem by the gradual introduction of an Electric Probe (these caps are by author and reviewer), for example, is as rational as if a similar instrument were to be thrust gradually through human skin, muscle, rib, cartilage and membrane into arteries, veins, lungs or nerves and the resulting disturbances read on a galvanometer.

Bose seems to be so impressed with the precision of his recorders and electrostatic apparatus that the vastly greater delicacy of colloidal structure, equilibria of membranes, and molecular adjustments in living matter are ignored. The wreckage which ensues when the terminals of the various apparatuses are thrust into plants seemed to be disregarded, an attitude which is perhaps wise on the part of those who have no

conception of the nature of protoplasmic mechanism. When an electric circuit is closed through the tissues of a plant, rhythmic disturbances are recorded. These pulsations on the basis of pure assumption are translated into a "pumping action" of the living cells which moves material through the stems at great speed. It would be equally justifiable to take the click of car wheels on the rails as constituting the motor forces which propel a train.

To attempt to analyze the formal recognition accorded Bose in Great Britain would entail a discussion of features of Anglo-Indian relations well-outside of the domain of knowledge of the fundamental properties of living matter or of the functionation of plants.

As against the harm done by reckless writing which would make a sort of animal out of plants, we may credit Bose's utterances as having done something to detach the layman from the mistaken conception that matter, living or non-living, is inert.

D. T. MacDougal,
Director.

Laboratory for Plant Physiology,
Carnegie Institution of Washington.

All-inclusive

Here is an interesting proposal, submitted by Charles H. Clark, a mechanical engineer, of New York. Mr. Clark has been studying the condensed table of ethereal waves published on page 150 of our March, 1926, issue, and believes a better and more systematic method of indicating wavelengths could be devised. He has devised one, which we reproduce in these columns. If physicists and astronomers would adopt such a system as this a great many things would be simplified.

Clark's Table of Ethereal Waves

Stellar Metric Scale	1,000 sm = 1 skm	(stellar kilometer)	= 1,000,000,000,000,000,000,000 meters
	1,000 smm = 1 sm	(stellar meter)	= 1,000,000,000,000,000,000 meters
	1,000 ukm = 1 smm	(stellar millimeter)	= 1,000,000,000,000,000 meters
Ultra-Metric Scale	1,000 um = 1 ukm	(ultra-kilometer)	= 1,000,000,000,000 meters
	1,000 umm = 1 um	(ultra-meter)	= 1,000,000,000 meters
	1,000 km = 1 umm	(ultra-millimeter)	= 1,000,000 meters
Metric Scale	1,000 m = 1 km	(kilometer)	= 1,000 meters
	1,000 mm = 1 m	(meter)	
	1,000 ikm = 1 mm	(millimeter)	= .001 meter
Infra-Metric Scale	1,000 im = 1 ikm	(infra-kilometer)	= .000,001 meter
	1,000 imm = 1 im	(infra-meter)	= .000,000,001 meter
	1,000 akm = 1 imm	(infra-millimeter)	= .000,000,000,001 meter
Atomic Metric Scale	1,000 am = 1 akm	(atomic kilometer)	= .000,000,000,000,001 meter
	1,000 amm = 1 am	(atomic meter)	= .000,000,000,000,000,001 meter
	= 1 amm	(atomic millimeter)	= .000,000,000,000,000,000,001 meter

A Correction

While we always do our best to insure accuracy in this magazine, particularly as to proper names, occasionally, as is indicated by the letter printed below, we slip up. However, we admit our fault and extend our apologies to the Quincy Chamber of Commerce.

Editor Scientific American:

It has been called to the attention of this Chamber of Commerce that in the August issue of your magazine, in an article entitled "Giant Floating Aircraft Bases," mention was made of the airplane carrier *Lexington*, being built at the "Fall River Shipbuilding Corporation, Quincy, Massachusetts," the latter being incorrect. This should read "Fore River Shipbuilding Corporation, Quincy, Massachusetts."

We should be pleased to have this correction published. Thanking you for this favor, I am

Very truly yours,
John F. Scott,
Secretary Quincy Chamber of Commerce.

Eagle-eyed?

Not everybody took lying down the statement quoted in the May issue of the Scientific American, page 337, to the effect that Venus was the only star that could possibly be seen in the broad daylight, even from the shady depths of a silo or a mine shaft. The letter published below was written by a member of the Springfield, Vermont, group of amateur telescope makers, described in the November, 1925, issue of the Scientific American. Mr. Marshall hopes to demonstrate that the star, *Sirius* may thus be seen. To establish beyond doubt of error the visibility of stars in daylight would prove, in the last analysis, almost as difficult as establishing the objective reality of some pyschic phenomenon seen by a small number of people. Mr. Marshall's proposed method is at least scientific. It looks as if this matter of daylight visibility of stars (except Venus, which practically everyone concedes) might turn into a controversy, and controversies are always interesting.

Editor, Scientific American:

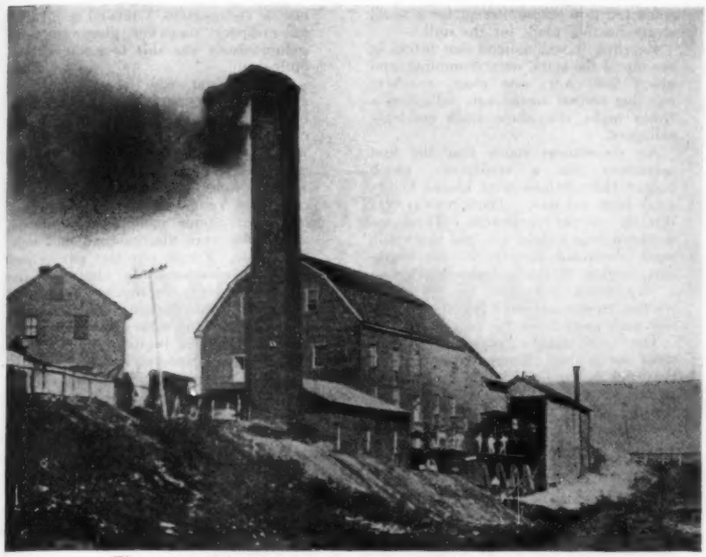
Having seen in the recent issues of several monthlies—notably the Scientific American—discussions of the old tale about seeing stars from a well or a mine shaft, during daylight hours, my interest in the subject has been slightly stirred, chiefly by the omission of at least two important features related to vision. These features are: first, the tube or any optical instrument, particularly the telescope; and, the individual eye capacity; and second, the varying capacity of different optical instruments designed for bringing distant objects within closer range of the observer.

I believe that while engaged in demonstrating the foolishness of thinking one may see stars by daylight, we ought in fairness to the badly informed, or to the gullibly inclined, to show under what conditions it is possible to see stars by daylight.

Take the subject of the tube first. If any one has had opportunity to look through a tubeless telescope by daylight, and at the same time could compare its seeing qualities with those of an instrument having a tube, the decided difference in favor of the one having the tube would be all too apparent. Why? Because the tube shuts out all light except that which comes from the immediate vicinity of the object at which the instrument is directed. Take for example a certain type of Cassegrainian telescope on which no tube is used; it is scarcely possible to get an image of the ordinary landscape at daytime, owing to the so-called "irrelevant" light. This comes in at all angles from the horizontal plane of the objective in the direction of the object which one attempts to see.

It is just within the bounds of possibility that sometime or other someone has seen from a deep well or coal-mine shaft, perhaps at or immediately after sundown, some bright twinkling object, which he thought was a star. The object may have been Venus, or possibly Jupiter. It should be noted that the average person makes no distinction between a star and a planet; and not many people know that there is any difference until it is explained to them.

Concerning the individual capacity of the eye, almost everyone knows that there is a marked difference in the visual capacity of different person's eyes. Let any one who will, try a pair of common bird glasses which usually have a magnification of three or four times that of the normal eye. Let such a one point them to the stars and he will be astonished at the number which he can see, which the unaided eye does not note. A power of only three times over the eye is not much. I have a friend who can see, in the early twilight, stars which I find it difficult to see when it has become totally dark. And I am not



The original brick chimney as it stood for many years

afflicted with anything at all like poor vision. But my friend has a most extraordinary eye.

The function of the large or objective lens of any telescope, binocular, or field glass, is to increase the light-gathering power over that which the eye possesses. Here again it should be pointed out that an instrument of low power with a high light gathering capacity will quite often more clearly reveal some faint object which a higher powered instrument having a smaller light grasp will fail to show.

Finally, it should be borne in mind that in attempting to see a first magnitude star against a daylight sky, not a little depends on how much of the surrounding illumination may be eliminated. Not many weeks from now Sirius will be in the daylight skies and I shall set my instrument on it, then reduce the eye-piece in magnifying power until I reach the vanishing point, or until nothing but the objective is in use. I shall call to my aid my keen-eyed friend above mentioned, to learn just what he can see. If he can see Sirius without an eye-piece, I shall try him with the tube only. The results, if you care for them, I shall be only too glad to send to you.

(Signed) O. S. Marshall.

A Quiet Chimney Collapse

That an 80-foot brick chimney should completely collapse with no more noise than that occasioned by the passing of a heavy truck is indeed unusual. One of our readers living in the town where this happened has taken the trouble to collect some data on the chimney and has forwarded it to us, together with some very interesting "before and after" photographs.

Editor, Scientific American.

I am enclosing a series of photographs of a very unusual occurrence in connection with the recent collapse of a brick smoke stack at the old Elder and Eckbert flouring mills in Lewistown, Pennsylvania.

This brick mill and the stack were erected in 1855. The stack was eight feet square at the base and about 80 feet high, built of ordinary country, kiln-burned, red clay brick, and consisted of a round inner chimney, reinforced by the square-walled stack, all laid in old-fashioned lime mortar.

The foundations below the ground level are of cut stone and still are intact. The stone foundations were originally well above ground, but in later years, gradual earth fills extended slightly above them.

About 20 years ago it was discovered that frost and moisture were causing the bricks at the base of the courses of the stack, to crumble and disintegrate, thus apparently endangering its stability.

To remove this menace and strengthen the base, a supporting buttress of 10-inch concreted brick, about four feet high, was built around three sides of the stack, leaving the southern exposure, which was apparently intact, without such additional support.

About 12 years ago electricity was substituted for steam in operation of the mill—the brick boiler house at the base of the stack was removed—and the

After the collapse. Not a vestige of the chimney remains

stack fell into disuse, except for a small steam heating plant for the mill.

Recently it was noticed that bricks at the top of the stack were crumbling, and about 9:30 A.M., one clear, sunshiny morning several weeks ago, following a frosty night, the whole stack suddenly collapsed.

An eye-witness states that the first movement was a settlement, which bulged the reinforcement blocks bodily away from the base. The top sway was directly to the northwest. Then the southern base bulged out and the whole stack crumbled directly to the southeast, casting the bulk of the bricks into a depression occupied by an open wooden trestle, and in a direct and narrow path away from the base.

The photographs reproduced here show the original chimney structure and the brick boiler house as it appeared in 1896, the mill site immediately after the fall of the chimney and the brick pile left by the collapse. In the latter, note the complete separation of the bricks from the mortar, caused by the shock of the fall.

One concrete buttress lies as it fell and the other two are buried in the immediate front under the bricks, no part of which extend 24 inches above the roadway.

So little noise was occasioned by the collapse that some of the people living in the adjacent houses, only 30 feet distant from the stack, were not aware of its fall—attributing the noise to passing auto trucks.

The pile of bricks, showing how they were completely separated from each other

Had it continued its fall in the northwesterly direction, it would have undoubtedly have crushed the houses and killed or injured inmates of the three families occupying them.

I consider this a most remarkable occurrence.

Very truly,
W. F. Eckbert, Jr.,
Lewistown, Pennsylvania.

Seeing Stars

Some people's eyesight is known to be better than average and it is not yet *proved* that they cannot see stars by daylight. On this point, however, most astronomers "are from Missouri," for they maintain that, with the exception of Venus, neither stars nor planets can be seen until night. What experiences have you had?

Editor, Scientific American:

While on the subject, "Can Stars Be Seen by Daylight," page 337 of the May number of the Scientific American, your readers may be interested to know that the planet Jupiter can be seen by daylight. Some twelve or fifteen years ago, one Fourth of July, I was able to see Jupiter with the unaided eye two minutes before sunset. Venus and Jupiter at that time were only about ten degrees apart. Venus was easily found, and knowing the direction and distance of Jupiter, I knew its position. Within one or two degrees, I picked it up with an ordinary six-power glass and just before sunset was able to see it without optical aid.

My daughter, who is a high school student, and I saw Jupiter several times by daylight during November and December of last year. The earliest time was ten minutes before sunset Thanksgiving Day, November 26. Venus and Jupiter were near each other. We could see Venus early in the afternoon but light clouds came over from the west. We were disappointed and went for a ride. Forgot our star gazing and then the clouds, while obscuring the sun, broke away in the southwest and there like a diamond in the sky was the planet Venus and some 10 or 12 degrees away, the planet Jupiter.

Sincerely yours,
(Signed) E. W. Moore, D.M.D.

Another Telescope Enthusiast

Good luck to you, Mr. Davies! We hope your telescope will be a great success, and as you have been such an enthusiastic reader of the Scientific American we should say that you are starting with the odds very much in your favor. Let us know how you are progressing.

Scientific American Publishing Co.,
Dear Sirs:

The last three issues of the Scientific American (February, March and April) have interested me more than any previous copy because they dwelt to such length on a subject that has been nearest my heart for years. I have read the magazine assiduously for a long time and have studied astronomy ever since I had to stand on tiptoe to kick a duck in the pants. The desire to own a telescope has always been paramount and the recent articles have certainly fired me with an ambition to make one.

What qualifications I have, to enable me to make a telescope need to be found out, but if it takes patience and an infinite capacity for detail, I have nothing else but. Pattern making has been my trade for 25 years and during this interval I have enjoyed a wide experience in automatic machinery, models and inventive work where precision counts. Perhaps I can see as far through a mill-stone as the fellow who made the hole in it. As soon as I receive your book, I will be all set.

I have received circular letter LC 32 from the Bureau of Standards and also a copy of Monthly Notices for March, 1909, from the Royal Astronomical Society, London. The article in this issue by the Rev. C. P. Davies, on mirror making, is excellent, but he lays particular stress on the point of zonal measurement and abberations. This may be my stumbling block. We shall see if the scientific training of the Davies family can be carried on.

Very sincerely yours,
Kenneth Davies,
Hollywood, California.

THE WISE MEN OF INDIA

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As to the value they place upon the Scientific American, witness what a Bombay business man wrote recently:

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Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

Conducted by Milton Wright

Don'ts for Inventors

YOUR patent attorney, who is registered to practice in the United States Patent Office, is not likely to be the man to seek to steal your invention. You can trust him with all the facts you have about your invention. He needs all those facts in order to get you the best patent possible. Withholding information from him may even result in a patent that is invalid. *Don't hesitate to give your patent attorney all the information he asks.*

Some inventors are even so careful that they fear to disclose all the facts to the Patent Office itself, not realizing that the Patent Office must know all about the invention before it can give it the protection of a patent. *Don't be afraid to trust the Patent Office.*

Tradeless Trademarks

SUPPOSE you thought up a corking good trademark, but had no commerce to use it with. Could you have the mark registered in the Patent Office?

You could not. The mark must be used in interstate or international commerce or in commerce with Indian tribes before it can be registered.

This principle is emphasized by Acting Patent Commissioner Kinnan in refusing the application of the Los Angeles Creamery Company to register as a trademark the notation "Electruck." In an effort to comply with the law, the company had a truck bearing the mark driven over the Mexican border and back again in going from one section of California to another, but it was not contended that any sales were made outside the state.

"The only condition under which the Patent Office obtains jurisdiction to register a mark is where the owner of the trademark seeking registration has used it in commerce with foreign nations or among the several states or with Indian tribes," says Commissioner Kinnan. "Unless so used, the applicant for registration has no standing under the statute. It is well settled that such activities as the applicant has shown do not establish trademark use in commerce with foreign nations or between states."

Cook Book for Export

IT is all very well to export American food products to Europe, but what are the Europeans going to do with them when they get there? J. R. Wilkinson, American Consul at Zurich, Switzerland, has the answer. Distributing cook books in foreign markets may prove an aid to the sale of American prepared foods abroad, he suggests to the Department of Commerce.

Mr. Wilkinson states that in Switzerland the housewives are very much interested in acquiring a knowledge of cookery from recipe books and are using the books widely. One or two instances have come to his attention, he states, where sales of certain American products were materially increased by the local distribution of cook books setting forth directions for preparing certain dishes using these products. The books are printed in French and German.

Utmost care should be taken, according to Mr. Wilkinson, in the translation of the books on account of the diversity of dishes in various countries. For example, instruction for pie making would be very difficult if the translator had never seen an American apple or pumpkin pie.

Wide World

The convenience of traveling on a certain transportation line in London, England, is now enhanced by the installation, in stations, of the "pathfinder" device illustrated above. When one is in doubt as to the car that must be taken, it is only necessary to press a button labeled with the name of the desired destination and an indicator on the map will show the required information. The route covered is traced by illuminated dots. Not only is the most direct way to the destination given, but an alternative one is indicated

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Apparel

GARMENT SUPPORTER.—Adapted for use on men's trousers, in place of buttons, to engage with the ends of suspenders and the upper edge of drawers. Patent 1590985. J. M. Scallen, Soldiers' Home Hospital, Sawtelle, Calif.

ADJUSTABLE CAP.—Designed to permit of various head sizes by virtue of adjusting straps attached at their rear ends to the sides of the cap. Patent 1593452. A. Hertzman, 115 So. 7th St., Louisville, Ky.

Chemical Processes

METHOD OF TREATING WOOD.—For fireproofing and waterproofing the same, comprising submerging in a solution of salicylic acid, and carbonate of soda, allowing to dry, and applying a solution of hydraulic cement. Patent 1591752. W. P. Ferguson, 28 Cambridge Place, Brooklyn, N. Y.

REFINING PROCESS OF SUGAR JUICES BY CHLORINATION.—By blowing chlorine gas into sugar juice at a temperature of not more than 55 degrees Centigrade, and removing the active chlorine by adding an alkaline material. Patent 1591879. S. Ochi and F. Kotera, c/o T. Yuasa and R. Asamura, 819 Marunouchi Bldg., Tokio, Japan.

Electrical Devices

VARIABLE CONDENSER.—A double capacity apparatus wherein the parts may be independently roughly tuned, and then simultaneously adjusted for very fine tuning. Patent 1592775. O. G. Lissen, 151 Highland Ave., Jersey City, N. J.

ELECTRIC DISTRIBUTING SYSTEM.—Which may be used for molding in the wall of a room, to receive any number of connecting units in any desired position. Patent 1590,569. W. J. Fisk, 1523-A Turk St., San Francisco, Calif.

PLUG CONNECTION.—Which permits the two parts of the plug to be cast in such manner that the openings are provided when the parts are cast. Patent 1593084. A. H. Kline, 3581 Medill Ave., Chicago, Ill.

ELECTRIC PERMUTATION SWITCH.—By means of which a plurality of electric circuits having a common source of supply may be selectively closed or opened. Patent 1594288. H. D. Wethling, 318 Main St., Orange, N. J.

AUTOMATIC TURN-OFF SWITCH AND LOAD-LIMIT DEVICE.—Which may be used for overcoming the danger of fire due to loading a circuit to a fuse capacity and then fusing more heavily. Patent 1594096. L. S. Foltz, Michigan State College, East Lansing, Mich.

RADIOCOIL.—In which the woven strands of wire will be overlapped and intertwined so that there will be no possibility of the wires becoming disassociated. Patent 1594,292. A. E. Zierick, 322 E. 90th St., New York, N. Y.

Of General Interest

TRAVERSE ATTACHMENT FOR CURTAIN RODS OR POLES.—Wherein a clamping jaw is provided for gripping a rod, and means for firmly holding a single or double pulley wheel. Patent 1589559. H. Reubel, 107 E. 17th St., New York, N. Y.

FLOAT VALVE FOR FLUSH TANKS.—Which utilizes the pressure of the water supplied to the flush tank for closing and opening the valve and maintaining the valve tightly closed. Patent 1589786. A. C. Bradshaw, Los Angeles, Calif.

PORTABLE TENT.—Constructed to be transported upon the running board of an

What Is Mahogany?

CEASE and desist orders recently issued by the Federal Trade Commission against the Indiana Quartered Oak Company of New York, the Jones Hardwood Company of San Francisco, and the Thomas E. Powe Lumber Company of St. Louis are of particular interest to lumber importers, lumber dealers, furniture manufacturers and purchasers of household furniture. These companies are prohibited from using the term "Philippine" mahogany as applied to a wood which is not genuine mahogany.

The dissenting opinion of Commissioner Humphrey is especially interesting, however. He quotes the Interstate Commerce Commission to the effect that "the term mahogany applies to woods in two senses, the botanical sense and the commercial sense," and says:

"The 'milk in the cocoanut' in this controversy is that Philippine mahogany, being a product of one of our insular possessions, is admitted into this country free of duty, and this fact, together with the fact that it grows in considerable bodies, instead of single trees, as other mahoganies, enables it to be sold in the United States at a lower price than the other mahoganies, and its qualities are so appealing that it is becoming a serious competitor of the mahogany association."

After declaring that to lay down the rule that it is misleading to describe woods commercially other than what they are botanically, would injure, if not destroy, one of the greatest industries in the country, he continues:

"One of the finest woods in the world that furnishes perhaps more of the timbers used in construction today than any other is the Douglas fir of the Pacific northwest. It is known by this name throughout the world and by this name its qualities are well understood. Botanically this wood that enters so largely into the commercial life of a nation is a false hemlock. There is a widespread prejudice against hemlock, because of the qualities of that wood in the east. For the lumber producers of the northwest to be compelled to mark their product under its botanical name—false hemlock—would be to work incalculable injury to the industry."

General Burnside's Burnsides

THE lawyer who protested that there is no ivory in Ivory soap, no gold dust in Gold Dust washing powder and no bull in Bull Durham, now is joined in the annals of advertising legal lore by Alan Fox, attorney for Colgate and Company. The case was that of Ella C. Patterson, of Milwaukee, suing in New York for $150,000 damages because the shaving cream manufacturers featured in an advertisement the whiskers of her distinguished uncle, General Ambrose E. Burnside.

There is no disrespect to Washington because a coffee has been named after him nor to Lincoln, whose name is borne by an automobile, declared the lawyer. Neither have the descendants of Lord Chesterfield or Robert Burns complained to the cigarette and cigar manufacturers. English royalty has brought no action because the name of Queen Victoria's consort was bestowed on a frock coat.

Justice Erlanger, in deciding that the soap company could not be restrained from using the general's picture, said:

"Until the Legislature shall declare that the publication of the picture of a dead person without the consent of the heirs or next of kin is illegal, no action can be maintained either on the theory of libel or violation of the right of privacy."

automobile, yet when assembled will form a sleeping appliance. Patent 1590072. P. J. Belanger, Lake City, Minn.

COMBINED PIPE SUPPORT AND CLEANER.—Which prevents spilling of ashes, embers, by holding pipe bowl upright. Patent 1594311. Marcell Ludasy, Box 5, Lansing, Michigan.

SAMPLE CARD.—Adapted to receive sample carrying slips, as a single sheet or in book form, and arranged vertically or horizontally. Patent 1590098. J. Joseph, 447 E. 174th St., New York, N. Y.

COPING.—To be used in lieu of glazed tile copings, being of metal which will effectively interlock with a cement filling. Patent 1590119. H. C. Partridge, 1379, Flatbush Ave., Brooklyn, N. Y.

FILING SYSTEM FOR PHONOGRAPH RECORDS.—For safely and compactly storing records, despite their fragile character, and for rapidly selecting a particular record. Patent 1590148. E. Bergdal, Box 871, Seattle, Wash.

IRRIGATING DEVICE.—Adapted to discharge water beneath the surface in close proximity to the roots of young trees, shrubbery, and plants. Patent 1589400. H. A. Klinglesmith, Macomb, Ohio.

CONCRETE BLOCK AND WALL CONSTRUCTION.—Wherein reinforcing means serve as a bond between the adjacent blocks when the wall is built up. Patent 1587927. J. Teege, Bagby, Calif.

DETACHABLE HEEL FOR SHOE.—By means of which a dealer may readily provide a shoe with a leather or rubber heel according to the customers' desire. Patent 1588684. M. Mayorowitz, c/o Sidner, 1338 Prospect Ave., Bronx, N. Y.

SLED.—Having runner sections capable of adjustment to act as a brake for bringing the sled to a sudden stop in an emergency. Patent 1589110. F. J. Caronia, 218 Kingstand Ave., Elmhurst, N. Y.

CURLING IRON.—Which embodies means for facilitating the wrapping or curling of strands of hair for the curling thereof. Patent 1589117. J. R. Cotter, 1166 Gates Ave., Brooklyn, N. Y.

FILING DEVICE.—Comprising a support, fixed and movable spindles secured thereto, and means for moving the movable spindle to alignment or disalignment. Patent 1588,947. W. L. Dinsmoor, c/o Central Natl. Bank, Pasadena, Calif.

APPARATUS FOR PRESERVING PERISHABLE SUBSTANCES. — Such as vegetables and fruits, wherein the parts are so arranged as to be readily removed for cleaning or sterilizing. Patent 1589215. C. De F. Ordway, Burlington, Vt.

WINDOW WEDGE.—Which will serve the dual purpose of limiting the sliding movement of the sashes, and preventing rattling. Patent 1589231. S. J. Rumbold, R. D. 2, Nicholson, Pa.

SUBMARINE RELIEF VALVE. — Whereby communication with men in sunken submarines may be maintained, and also air and food supplied, and gas or liquid removed. Patent 1589113. E. L. Chisling, 2 W. 47th St., New York, N. Y.

GRAVE MARKER.—In which a standard for supporting the inscription bearing tablet, may be driven into the ground at the head of the grave. Patent 1589199. J. M. McNeill, 1015 Main St., St. Joseph, Mo.

GARMENT HANGER.—On which the garment is fastened to the hanger, thus preventing the garment from slipping off or being stolen. Patent 1589213. H. Nygren, 815 Crescent Place, Chicago, Ill.

PIPE CLEANER.—For the cleaning of sewer pipes, may be slidably actuated, reciprocated and gyrated for cleaning and scraping the inner walls. Patent 1588737. G. Hurd, 1427 Clay St., Napa, Calif.

FRUIT-PICKER'S RECEPTACLE.—In the form of a pail, which conforms to the contour of the body, prevents undue bruising of the fruit, and facilitating the picking. Patent 1589077. H. S. Hooper, c/o A. L. Humboldt, San Francisco, Calif.

METHOD OF BLEACHING SOLE LEATHER.—Which consists in dipping the leather in a number of solutions adapted to produce after drying a uniform color not subject to cracking. Patent 1588686. J. Raisor, c/o D. S. Merserean Office of Clerk, Union, N. Y.

CLASP.—For use in connection with watch fobs for locking the same in a reliable manner against accidental or unauthorized removal. Patent 1588630. H. K. Smith, 56 Pier Ave., Hermosa Beach, Calif.

ARTIFICIAL BAIT.—Adapted alike for trolling or still fishing, and for movement through weeds and other water plants without catching. Patent 1588690. E. J. Babbitt, 35 E. 8th St., Holland, Mich.

FOLDING TABLE.—A foldable frame provided with legs and hinged means for a top, which permit the top to be located in a plurality of positions either when the frame is extended or folded. The inventor has been granted two patents 1588759 and 1588,760. F. C. Lewis, Ethical Culture School, Central Park, West and 63rd St., New York, N. Y.

WELL TUBING. — More particularly a screening device adapted to be incorporated in a well tube of usual construction, to permit the infiltration of liquid. Patent 1588,920. P. O. Trahan and F. M. Kile, Gueydan, La.

FRUIT PICKER'S BAG.—Including means by which the entrance end is held open, and a yielding action allows comfort to the packer's body. Patent 1588094. W. L. Chambers, 138 So. Main St., Los Angeles, Calif.

REFRIGERATOR.—Having means for supporting articles so that they will move to position within the food compartment when the door is closed. Patent 1589306. J. M. Short, 1020 E. 8th St., North Little Rock, Ark.

STEAM TRAP.—Which will operate from low to high temperature without necessitating any adjustment, and will not be damaged by varying temperatures. Patent 1588919. W. Telfer, Manitoba Sanatorium, Ninette, Manitoba, Canada.

FIRE PREVENTING AND EXTINGUISHING MEANS.—For preventing combustion of inflammable liquid in a storage tank, and extinguishing the flame should the liquid become ignited. Patent 1590877. W. Black, 4844 Constance St., New Orleans, La.

POULTRY FEEDER.—In which the distribution of feed from the hopper may be regulated, and is actuated by the movement of the poultry. Patent 1590909. J. Roat, Canandaigua, N. Y.

STRAINER CUP FOR VARNISH AND THE LIKE.—For wiping the excess varnish from a brush and straining the excess as it passes back into the cup. Patent 1590572. A. Fredett, 1621 W. 32nd St., Chicago, Ill.

CHIMNEY STOP.—For fireplace openings, securing a cover substantially air-tight to prevent the passage of cold air and dust. Patent 1590396. J. H. Sutton, Box 144, La Grange, N. C.

MAIL-BAG LOCK.—Permitting the ropes movement in one direction to close the mouth of the bag, but preventing movement in a reverse direction. Patent 1590258. R. L. Shannon, 501 Lyman Ave., Oak Park, Ill.

WATER COOLER.—Having an assemblage which may be associated with any demijohn, for serving to control the flow of water through the cooling chamber. Patent 1591,799. G. W. Tinapp, 5313 6th Ave., Brooklyn, N. Y.

UMBRELLA AND RIB TIP THEREFOR.—The tip being of novel form to provide for a novel and characteristic manner of securing the umbrella cover to the tip. Patent 1591,880. M. Ornstein, c/o S. Ornstein & Sons, 174 Madison Ave., New York, N. Y.

CABINET AND CARRIER LOCK THEREFOR.—Wherein metallic shelves are provided, each shelf being formed with a depending resilient support having finger holes for reaching the tickets. Patent 1591774. O. S. Payzant, 166 E. 42nd St., New York, N. Y.

BELL BUOY.—In the nature of a spar buoy carrying bells, primarily intended for the convenience of navigators of relatively small craft. Patent 1591751. G. A. Ebert, Egg Harbor City, N. J.

SMOKING DEVICE.—Which cooperates with the usual type of pipe stem passage for preventing the same from clogging up with tobacco and nicotine. Patent 1591742. J. C. Cady, 29 Broadway, New York, N. Y.

GARMENT HANGER.—Readily collapsible when not in use, can be packed away in a small space such as a suit case. Patent 1591334. J. P. Paddington, c/o Paddington Sales Co., 516 E. 72nd St., New York, N. Y.

ATTACHMENT FOR BOATS.—For deflecting outwardly from the sides of the hull of a boat water which would otherwise impinge with relatively great force. Patent 1591748. F. C. Dieckmann, 910 Kirbert Ave., Cincinnati, Ohio.

TOBACCO AND PIPE POUCH.—With ample provision for the tobacco and a convenient pocket for the pipe the tobacco affording a cushioning for the pipe. Patent 1591340. E. S. Steinhardt, 8846 70th St., Woodhaven, N. Y.

CLOSURE OPERATOR AND RETAINER.—For releasably securing and holding a swinging closure in any one of a plurality of different positions. Patent 1591650. W. A. Tomlinson, R. 5, Box 46, Phoenix, Arizona.

HIGHWAY CONSTRUCTION. — Providing means in the roadbed of a highway for forcing an approaching vehicle to slow down on coming near a railroad crossing. Patent 1590526. E. D. Kinney, P. O. Box 827, Twin Falls, Idaho.

SHOE SOLE.—For "stitch-down" shoe structures, which is comparatively simple, inexpensive and highly efficient in its purpose. Patent 1592751. G. F. Azzara, 388 Melrose Ave., Brooklyn, N. Y.

KNOCKDOWN TRELLIS.—Capable of being spread out in fan-like shape for use in connection with plants and flowers, may be readily packed for storage. Patent 1592764. H. A. Hamilton and D. J. Enright, c/o H. A. Hamilton, 54 Magnolia Ave., Jersey City, N. J.

CONDIMENT HOLDER.—Having means for closing the openings in the top when in upright position, without interfering with its free use in dispensing position. Patent 1592035. M. P. Massuere, Deerwood, Minn.

REPAIR DEVICE FOR RULES.—A simple, cheap and effective means for connecting breaks in jointed rules, adjacent or between the joints. Patent 1592811. F. W. Fleer, 281 Tompkins Ave., Brooklyn, N. Y.

COMBINED MILK BOTTLE OPENING AND COVER.—Constructed to take the place of the regular cover on a milk bottle after the latter has been removed. Patent 1590557. R. B. Spikes, 1147 7th St., Fresno, Calif.

INCUBATOR.—Having means whereby all the eggs may be turned in a single operation without endangering the life of the embryo chick. Patent 1590549. S. R. Ramsay, 347 No. Branciforte Ave., Santa Cruz, Calif.

CARD INSCRIBING DEVICE.—By means of which an inscription may be made upon a card with sealing wax or the like, having the appearance of embossing. Patent 1592148. J. W. Munn, 2746 Hampden Court, Chicago, Ill.

POULTRY FOUNTAIN.—Which affords facilities for holding drinking water fed until a predetermined level has been reached, and then automatically stopped. Patent 1593,172. M. W. Heatherington, R. F. D. No. 2, Orlando, Fla.

HEAT INSULATED VESSEL.—For carrying different commodities whose mixture is to be avoided and whose hot or cold state is to be preserved. Patent 1593142. A. M. Seran, Wewoka, Okla.

METHOD OF INSTALLING MUSHROOM PILING.—In beach sand, the sand forming a mold into which concrete may be poured, no special means being required for forcing the concrete into mushroom shape at the base. Patent 1593445. J. V. Ferry and A. P. Miller, c/o James Ferry Co., Virginia and Mediterranean Aves., Atlantic City, N. J.

NONREFILLABLE BOTTLE.—Which will readily permit the proper emission of the contents, but whereby the parts when assembled cannot be removed without destruction. Patent 1593464. G. A. Pagonis, 5 Columbus Circle, New York, N. Y.

CONTAINER.—For use in motion picture studios, or places where scraps of nitro-cellulose film or combustible material must be disposed of. Patent 1593462. F. Nally, 308 W. 18th St., New York, N. Y.

SECTIONAL BUILDING.—Which may be readily set up in the field to form a complete building, after which the wall coverings may be placed thereon. Patent 1593424. P. L. Braunworth, Walnut St., Bloomfield, N. J.

METAL STAIRWAY CONSTRUCTION.—Which is comparatively simple in its construction and mode of assembly, eliminating rivets and bolts, yet is strong and durable. Patent 1593418. E. Berson, 1784 Bryant Ave., New York, N. Y.

APPARATUS FOR THE RECEPTION AND TRANSMISSION OF SOUND.—Constructed to preserve the purity of the sound and prevent the formation of parasitic noises caused by vibrations. Patent 1593457. G. Lakhovsky, c/o C. Chassevent, 11 Boulevard de Magenta, Paris, France.

OPTICAL DEVICE.—The operation of which will produce exceedingly harmonious color schemes which will attract instant attention to any particular location. Patent 1593419. S. M. Bielecki, 43 W. 177th St., New York, N. Y.

CURTAIN TIE AND SHADE PROTECTOR.—Which not only supports the lower ends of the curtains in a graceful position, but prevents the corners of the shade tearing the curtain. Patent 1593156. E. M. Barsch, 812 Eveline St., St. Joseph, Mo.

PICTURE FRAME.—Formed from metal, and so constructed that it may be used upon a wall, or upon the polished surface of a desk, without scratching the same. Patent 1594339. J. W. Robertson, c/o Robertson Metal Arts, Inc., 210 E. 40th St., New York, N. Y.

FOOT RULE.—For use by footwear salesmen, wherein an adjustable stop is provided formed to remain in any position in which it is left. Patent 1594255. W. T. Goldsmith, 391 Mulberry St., Newark, N. J.

SOIL-PIPE-CLEAN-OUT CLOSURE DEVICE.—Which greatly facilitates the closing and opening, yet when in closed position is fluid-tight and prevents the escape of noxious gases. Patent 1592382. A. N. Munn, 542 West Belgrave Ave., Huntington Park, Calif.

Hardware and Tools

CHEESE CUTTER.—Having means whereby a cut of predetermined width may be made, and the segment of cheese easily removed. Patent 1591839. I. S. Karraz, Brinkley, Ark.

RAKE.—Having an attachment in the form of flat spring teeth especially adapted for removing light articles, such as leaves from the ground. Patent 1591738. C. H. Bell, c/o J. M. Shaw, Bellport, L. I., N. Y.

MICROMETER.—In which the parts may be capable of being adjusted to each other to an extent sufficient to compensate for wear. Patent 1591740. J. Brewer, 1326 Hoe Ave., New York, N. Y.

ANGLE BRACKET.—Constructed of cheap metal, and shaped to connect two members at right angles, and provide a strengthening and bracing medium. Patent 1591869. G. P. Wiedman, c/o Wiedman Body Co., North Tonawanda, N. Y.

WRENCH.—Having means in connection with the shanks to adjustably limit movement of the jaws away from one another. Patent 1592759. A. K. Ersland, Box 303, Manhattan, Calif.

GAUGE COCK.—Which will be actuated by gravity to close tightly even though wear has taken place on the relatively movable parts. Patent 1592350. F. A. Fields, c/o E. S. Rutherford, Three Sands, Okla.

BALL BEARING.—Which will be effective either as a radial or as a thrust bearing whether the thrust be in either direction. Patent 1591395. M. G. McNeely, Oakland, Calif.

SAFETY RAZOR.—So adjustable relative to the handle that any desired shaving angle may be obtained, and the usual barber stroke permitted. Patent 1593459. D. H. MacFalls, 70 Delap St., Jamaica, N. Y.

PIPE BENDER AND VISE MOUNT.—Which may be advantageously employed for bending or shaping a pipe or rod as desired. Patent 1593793. M. Chapin, 11790 Ilene Ave., Detroit, Mich.

METAL PAIL AND COVER.—Whereby the pail may be effectively sealed to prevent dilution or substitution of its contents, yet may be readily opened without tools. Patent 1593633. S. M. Johnson, c/o Ohio Pail Co., Middlefield, Ohio.

FAUCET.—From which water may flow in a uniformly smooth stream when the faucet is open, but will instantly stop on the closing. Patent 1593968. J. J. H. Edling, 4058 W. Euclid, Detroit, Mich.

Heating and Lighting

HEATING APPARATUS.—For stoves, with which is incorporated a hood having openings at the top through which the heated air is discharged. Patent 1591161. C. E. Draper, Elks Club, Indianapolis, Ind.

WATER HEATER.—Of the kitchen type, by which water may be heated in the boiler or in the external pipe when a limited quantity is desired. Patent 1592800. H. G. Weilage, Crete, Neb.

KILN.—So constructed that heat not needed in any kiln of a series, may be collected and transferred to another point for use. Patent 1594315. M. M. Minter, 918 Broad St., Columbus, Ga.

AUTOMATIC OIL-BURNER-CONTROL APPARATUS.—For use where furnaces are heated by fuel oil, to control such burners and ignite them when the temperature falls below a predetermined point. Patent 1591461. E. C. Wills, 330 Grove St., Newark, N. J.

Machines and Mechanical Devices

SAFETY ATTACHMENT FOR LEVELING DEVICES.—Relating to a braking or locking device for leveling attachments of harvesters or the like. Patent 1588197. H. C. Scott, Pomeroy, Wash.

CHECKING MECHANISM. — Particularly adapted for checking the movement of a door to closed position in order to prevent slamming. Patent 1586901. T. De W. Hubbell, 1605 So. Hoover St., Los Angeles, Calif.

METHOD OF AND MACHINE FOR FORMING SEAMLESS TUBING.—Whereby seamless tubing can be made directly from molten metal accurately and in less time than by usual methods. Patent 1590123. E. C. Riebe, 5 Place Vendome, Paris, France.

TOY CARNIVAL.—Comprising a plurality of toy units with mechanical means for operating all of them simultaneously in their respective modes. Patent 1589432. P. A. Sapp, c/o Kiddies Karnival Corp., Eufaula, Ala.

GRADIENT METER.—Controlled by a magnetic pendulum, the vibrations of such pendulum being clamped by its enclosure in a sealed box of fluid. Patent 1589767. W. Tapley, c/o W. K. Ganong, Digby, N. S., Canada.

DECORTICATING FIBROUS MATERIALS.—By feeding the material between rotating rollers which are also moved longitudinally in relatively opposite directions. Patent 1590085. H. J. Craymer, c/o H. J. C. Forrester, 88 Chancery Lane, London, W. C., England.

PIN SETTING APPARATUS.—Which will automatically set the pins of bowling alleys and will also return the balls to the players. Patent 1590124. P. Roble, c/o A. Martinez, Columbian Bureau of Information, 1440 Broadway, New York, N. Y.

FLOOR POLISHER.—For use as an attachment for vacuum cleaners, adapted to hold a polishing agent in frictional contact with the surface traversed. Patent 1588943. J. F. Clark, 308 Hass Bldg., Cor. 7th and Broadway, Los Angeles, Calif.

PRINTING PRESS.—In which the drive for the various rolls is considerably simplified by the use of a chain passed around them. Patent 1587772. W. H. Granger, 323 De Young Bldg., San Francisco, Calif.

SOUND RECORDING AND REPRODUCING DEVICE.—By means of which, speeches or songs made by actors while a motion picture is being produced may be recorded in synchronism with the taking of the picture. Patent 1588706. E. E. Cothran, Wright, Calif.

POCKET-CLOTH MEASURING MACHINE.—Which is sufficiently small to be carried and operated by hand, and readily moved along the cloth, or the cloth moved therethrough. Patent 1589184. S. Levy, 5 Bridge St., Paterson, N. J.

SELECTOR MECHANISM FOR TYPEWRITERS.—Adapted to be used when connected with an electrically operated typewriter, or an electrically actuated mechanism for an ordinary typewriter. Patent 1589159. G. A. Henriques and A. Dias, c/o Henriques & Dias, 121 W. 79th St., New York, N. Y.

AUTOGRAPHIC REGISTER.—More particularly to mechanism for holding, and for facilitating the feeding of paper on rolls. Patent 1589223. W. E. Pratt, 645 Mill St., Reno, Nev.

PROCESS FOR THE PRODUCTION OF WOOD PULP.—Consisting in cutting wood across the grain into short blocks, crushing the blocks into slivers, and beating the same into pulp in the presence of water. Patent 1587790. H. F. Puttaert, 2920 Webster St., San Francisco, Calif.

DISPLAY DEVICE.—Whereby a series of advertisements can be successively displayed through a suitable opening, and illuminated selectively by colored lights. Patent 1589,292. G. Chortanian and C. Atamian, 440 7th St., West New York, N. J.

MACHINE FOR MOLDING INSOLE FLANGES.—Into a predetermined shape, thereby making them more readily accessible to the anvil of a lasting machine. Patent 1590904. A. H. Prensel, Halifax, Pa.

LOADING AND CONVEYING MECHANISM.—Having novel flights positioned at such an angle to the belt that material will be conveyed without danger of rolling or slipping. Patent 1590883. C. A. Bryant, c/o Portable Machinery Co., Passaic, N. J.

MERRY-GO-ROUND.—Which may be turned by children, either by engaging the ground with their feet, or by grasping the merry-go-round arms and running about the axis. Patent 1590887. H. D. Clayton, Hill City, Kansas.

ATTACHMENT FOR ADDING MACHINE.—Easily applied and removed, will effectively prevent the operation of the machine unless certain parts are in proper position. Patent 1590946. J. R. Kaiserman, c/o R. M. Keister, Bozeman, Mont.

CONVEYER BELT.—Having cleats that will be particularly effective in retaining the load and minimize any tendency of the material to roll back. Patent 1590884. C. A. Bryant, c/o Portable Machinery Co., Passaic, N. J.

OPERATING MECHANISM FOR ICE-CREAM FREEZERS.—Whereby the operator may utilize an easy back and forth movement to impart a continuous rotary movement to the dasher shaft. Patent 1591337. F. G. Scott, 3225 Palmyra St., New Orleans, La.

HIGH-SPEED FREE-CHAIN HOIST.—Well adapted for use by linemen and others for elevating and tensioning heavy rods, wires, cables and the like. Patent 1591362. F. W. Coffin, c/o Lockwood & Lockwood, Fletcher Trust Bldg., Indianapolis, Ind.

PACKING.—Which is leak-proof and automatically self-adjusting to compensate for wear on the relatively moving parts, and temperature changes. Patent 1591876. C. A. Neal, Rock Mart, Ga.

WINDMILL SAFETY PIN.—Which will automatically turn to the safety position and prevent displacement, but may be readily positioned for convenient removal. Patent 1591781. C. F. Ried, Palmyra, Neb.

MACARONI MACHINE.—For forming macaroni of twisted or spiral form, and in addition providing a hollow passage therethrough. Patent 1592769. V. Imparato, 183 W. 97th St., New York, N. Y.

SHOE OR PLATFORM RAISING DEVICE.—For use as a substitute for scaffolding, which may be used as an individual elevating device or for supporting one or more workmen. Patent 1592770. C. Liberman, 1732 Madison Ave., New York, N. Y.

WINDMILL.—Having a plurality of fans adapted to revolve in opposite directions on a common axis to increase the power development. Patent 1590495. P. R. Campion, Stratford Hotel, 241 No. 1st St., San Jose, Calif.

DECORTICATING MACHINE.—Which automatically grips the leaf, strips the skin therefrom, takes off the pulp, presses the fibers and delivers the fibers to a given point. Patent 1592761. A. Frey, San Juan de Guadalupe, Mexico.

PORTABLE TAPPING MACHINE.—For use in drilling and tapping pipes while the latter are in service conveying gases or liquids under pressure. Patent 1592754. T. F. Brackett and G. H. Boyd, c/o Munn, Anderson & Munn, 24 W. 40th St., New York, N. Y.

PIPE CUTTER.—Which is mounted upon a movable base that is adapted to be adjusted with respect to the vise that holds the pipe. Patent 1592169. F. J. Wilkinson, 3648 Monroe St., Gary, Ind.

AUTOMATIC AND MANUALLY-CONTROLLED CUT-OFF VALVE.—The automatic controlling element being not only collapsible under excessive heat, but also the valve may be manually released for closing from a distant point. Patent 1592403. E. C. Wills, 330 Grove St., Newark, N. J.

SPINDLE DRIVER.—Using a non-circular shaped spindle which will positively retain a shaft to rotate, at the same time permit free longitudinal movement. Patent 1592133. H. C. Brewster, c/o Oil City Iron Works, Shreveport, La.

Prime Movers and Their Accessories

MOTOR.—Driven by the hydraulic medium, and embodying oscillating cylinders, with each of which is associated an automatic distributing sleeve, which eliminate valves. Patent 1590225. C. L. Boisset, 436 Girod St., New Orleans, La.

CARBURETOR.—Having a venturi with inclined or tapering blades, bringing about a more perfect atomization, better combustion, and using a minimum of fuel. Patent 1591,553. A. Faber, 119 W. 95th St., New York, N. Y.

INTERNAL COMBUSTION ENGINE.—Having control means governed in such manner that when the engine is running slowly little liquid is introduced, while as the engine speeds up liquid is increased. Patent 1590,574. W. Goodfellow, 342 Lester Ave., Oakland, Calif.

Railways and Their Accessories

METAL CROSSTIE.—Having great strength and resiliency, special reinforcing means being provided for that portion of the tie just under the rails. Patent 1590235. M. V. Gearon 745 Cass St., Chicago, Ill.

PROTECTIVE DEVICE FOR RAILWAY CROSSINGS.—Whereby a train approaching the track crossing will automatically sound an alarm and close a gate, and passing the crossing will open the gate. Patent 1593521. J. K. West, Detroit, Minn.

SLACK ADJUSTER FOR AIR BRAKES.—By incorporating in the piston and plunger of a brake cylinder, means for periodically adjusting the brake shoes in respect to the wheels. Patent 1592969. W. S. DeCamp, 381 E. 2nd St., Chillicothe, Ohio.

RAIL-TIE PLATER.—A machine for applying tie plates to ties, and for properly positioning the ties on the base and under the tie plater device. Patent 1593423. R. A. Bradley, 24 Canal St., Merritton, Ontario, Canada.

Pertaining to Recreation

BATTING-PRACTICE CAGE.—For outdoor baseball practice, the device is intended to reduce the number of balls fouled into the stands and lost. Patent 1591753. F. K. Flaugh, Herald Tribune, 225 W. 40th St., New York, N. Y.

ICE SKATE.—Including a removable and reversible runner which permits of ready and effective sharpening, and maintaining a better condition of the blade. Patent 1591,778. J. Radus, 784 Cassidy Ave., Hazzard, Pa.

LAND AND WATER TOY.—Including a figure simulating an oarsman, and having propelling mechanism serving to give a rowing movement to the figure. Patent 1591749. J. L. Duggan, 214 Elizabeth Ave., Elizabeth, N. J.

GAME APPARATUS.—Which affords means for the playing of a game which embodies in well-balanced proportions the elements of skill and luck. Patent 1593421. J. Blum, 350 Corlies Ave., Pelham, N. Y.

TOY.—In which a spring motor is adapted to drive a mechanism for causing an alternating upward and downward movement to a figure. Patent 1594104. J. T. Miller, 302 E. 7th St., Clovis, N. M.

Pertaining to Vehicles

HEADLIGHT INDICATOR.—An attachment which will reflect back to the driver and will indicate whether or not the headlight lamp is lighted. Patent 1590947. A. E. Kammritz, 482 Franklin Ave., Hartford, Conn.

HYDRAULIC STEERING APPARATUS FOR TRACTORS.—So arranged that the motors of the respective treads can be run at different speeds in steering, instead of stopping one motor entirely. Patent 1590226. C. L. Boisset, 436 Girod St., New Orleans, La.

LOCKING DEVICE FOR IGNITION SWITCHES.—Easily applied to the ordinary construction of ignition switch without any changes, and without tools, effectually preventing operation by unauthorized persons. Patent 1590981. F. Lockyer, c/o Ideal Lock Mfg. Co., P. O. Box 33, Salt Lake City, Utah.

WAGON LOADER.—Adapted to be incorporated as a unit on any form of tractor for carrying movable arms to be oscillated for lifting a load. Patent 1591635. O. G. Mandt, c/o Mandt Construction Equipment Corp., Keokuk, Iowa.

AUTOMOBILE JACK.—Capable of being readily connected to the felly of a wheel for causing the wheel to be elevated upon rotation. Patent 1591731. J. T. Amiss, c/o Knox & Amiss, Baton Rouge, La.

GLARE CURTAIN.—To be applied to the windshield of an automobile to prevent the glare from automobiles approaching from the opposite direction. Patent 1591739. D. B. D. Blake, 112 Richmond Ave., Dayton, Ohio.

NONPNEUMATIC RESILIENT TIRE. — In which the parts are capable of ready removal or application whereby worn parts may be easily replaced. Patent 1591745. R. Curry, 540 E. 183rd St., New York, N. Y.

TIRE RIM.—Having stationary and removable flanges at the opposite sides, the removable flange consisting of circumferentially spaced radially projecting locking fingers. Patent 1591819. F. Hayward, 83 Woodhaven Ave., Elmhurst, N. Y.

SIGNALING WINDOW FOR AUTOMOBILES.—For vehicles of the closed type, by means of which the usual hand signals, required by law, may be effected without opening the regular window. Patent 1591785. J. Sharkey, 189 Montague St., Brooklyn, N. Y.

DRAIN VALVE.—Which may be employed in the drain opening of a crank case, the exterior parts being protected against damage. Patent 1591859. M. A. McCue, 146 Morris Ave., Long Branch, N. J.

TRANSMISSION GEAR.—Of few elements, readily thrown into position to produce a plurality of forward speeds and reverse. Patent 1591784. G. Q. Seaman, c/o J. S. Cunningham, 109 Hancock St., Brooklyn, N. Y.

TRAILER HOIST AND COUPLER.—For readily raising and lowering the front end of the trailer and for causing a ready connection and disconnection with the tractor. Patent 1591857. W. Mayer, 47 Gown St., Forest Hills, N. Y.

SHOCK ABSORBER.—For use on automobiles, which includes a novel form of oil seal for the joints between the relatively movable elements. Patent 1590565. F. A. Dowler, 1727 San Antonio Ave., Alameda, Calif.

DIRECTION INDICATOR.—In the form of a light hinged arm, adapted to be manipulated from the driver's seat, for indicating his intention to change direction or speed. Patent 1590548. J. M. and C. E. Quigley, 614 "S" St., Sacramento, Calif.

AUTOMATIC STARTER CONTROL AND NONSTALL DEVICE.—For automobile engines, which automatically throws in the starter of the engine as soon as the engine tends to stop. Patent 1592763. J. P. Geraghty, 481 Grove St., Jersey City, N. J.

BEARING.—For bicycles, motor-cycles, etc., which insures an effective lubrication of axle, shaft, bolt pin or other journal element. Patent 1593474. G. Serrao, c/o Attilio Serrao, 88 Cumberland St., Brooklyn, N. Y.

LOCKING DEVICE FOR AUTOMOBILES.—Having means for obstructing the movement of the controlling levers, preventing the car being towed or moved under its own power. Patent 1593815. A. Aasen, 3208 53rd St, S.E,. Portland, Oregon.

SPRING EQUALIZER.—Which consists of a lever mechanism allowing the spring end to play up and down as well as laterally. Patent 1593067. C. C. Goodrich, 639 Turk St, San Francisco, Calif.

SILVERED GLOBE AND ITS MOUNTING.—An incandescent bulb constructed to direct the rays from a headlight upon the roadway and to intercept certain rays causing objectionable glare. Patent 1594245. J. G. Davis, c/o L. L. Thalheimer, 1408½ Camp St., Dallas, Texas.

COMPRESSED-AIR AUTOMOBILE STARTER.—Having means for restoring the pressure of air in the tank immediately after carrying out a starting operation. Patent 1593810. F. M. Vermilion, Shattuck, Okla.

Designs

DESIGN FOR A SHOE.—Patent 70216. T. Davis, c/o Franklin, Simon & Co., 38th St. and 5th Ave., New York, N. Y.

DESIGN FOR A WOVEN FABRIC OR SIMILAR ARTICLE.—Patents 70462 and 70463. The inventor has been granted two patents of a similar nature. L. Bluhm, c/o Phoenix Mfg. Co., 40 Thomas St., New York, N. Y.

DESIGN FOR A SANDWICH TRAY.—Patents 70478, 70479, 70480, and 70481. The inventor has been granted four patents of a similar nature. O. Kopel, c/o Rowland & Marcellies, 139 5th Ave., New York, N. Y.

DESIGN FOR HOSE.—Patent 70506. J. L. McGarity, 418 Peters Bldg., Atlanta, Ga.

DESIGN FOR A SLIPPER ORNAMENT.—Patent 70572. Sara Myers, 27 Montgomery St., Gloversville, N. Y.

DESIGN FOR A NOVELTY CAT.—Patent 70,570. C. C. Moore, 226 W. 50th St., New York, N. Y.

DESIGN FOR A CHAIR OR THE LIKE.—The inventor has been granted two patents of a similar nature. Patents 70595 and 70596. M. Colt, c/o Gothic Shop, New Hope, Pa.

CONTENTS

OCTOBER 1926

ARTICLES

DEPARTMENTS

INDEX TO ADVERTISERS

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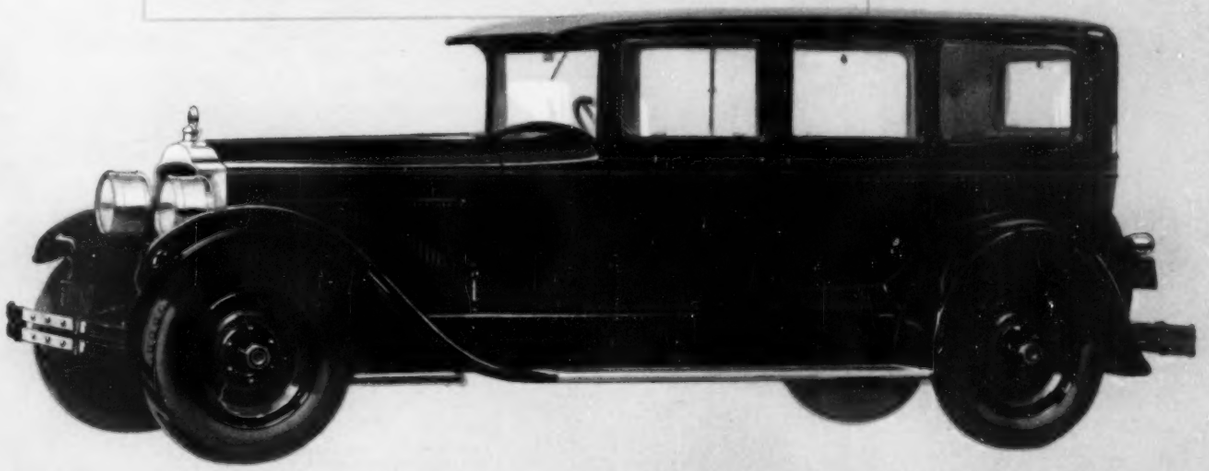

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